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Journal of Electricity

Devoted to the Economic Production and Commercial Application of Electricity
IN THE ELEVEN WESTERN STATES

Fynn-Weichsel

The Motor that corrects power-factor

New York—San Francisco In Fourteen Minutes

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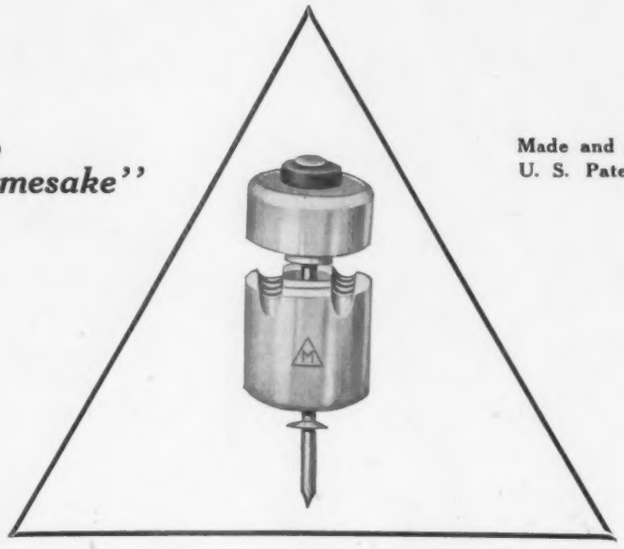
Wagner Electric Corporation, Saint Louis

THE "BULL DOG"
ASSEMBLED SPLIT KNOB

"Has a Grip Like Its Namesake"



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The BULL DOG ASSEMBLED SPLIT KNOB welcomes comparison. Note the recess in the bottom piece and the projection on the top which strengthens the knob; the leather washer; the metal assembling washer and the long cement coated nail. The porcelain is always of uniform high quality. The wire ways grip the wire firmly but do not tear the insulation. It's the knob for the job.

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IN THE ELEVEN WESTERN STATES

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New York to San Francisco in Fourteen Minutes

SINCE this issue of the Journal is devoted primarily to progress in the electrical sciences in celebration of the forty-eighth annual convention of the National Electric Light Association in San Francisco, attention is directed to the front-cover advertisement of the Wagner Electric Corporation embodying a unique use of the opportunity afforded by that latest scientific marvel, the telephotograph.

The total elapsed time between the sending and the receiving of the copy for this advertisement from the offices of Ray D. Lillibridge, Incorporated, New York City, to the Journal in San Francisco, was just 14 minutes —7 minutes for each negative.

This novel idea had its inception with the Lillibridge company; the N.E.L.A. Convention furnished the inspiration; and to the Journal has been accorded the distinction of publishing the first front-cover advertisement for which the copy has been transmitted by this method.

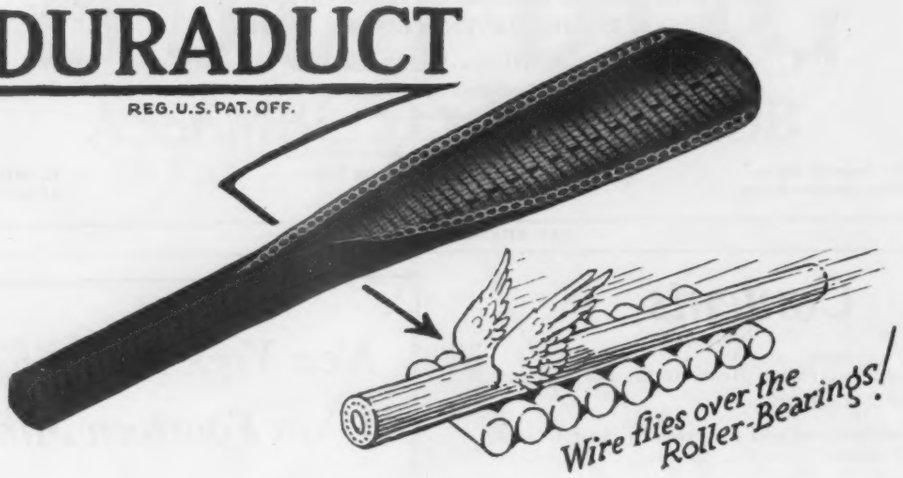
It is peculiarly fitting that electrical progress should be typified through the genius and enterprise of the American Telephone and Telegraph Company on an occasion such as this. Truly it would seem that we merely are entering into the dawn of an era of scientific achievement that will make the last hundred years seem as no more than the mere preparation of a foundation.

"What next?" is the question.

There's All Kinds of Speed in—

DURADUCT

REG. U. S. PAT. OFF.



SPEED in handling—because it is easy to cut and work. The cut is **clean**—no ragged edges to hold the wire back.

Speed in fishing—because the wire just **hits the high spots** on the Roller-Bearing Wireway of DURADUCT. That's what reduces friction. And that's what keeps the braid on the wire from slipping back and clogging up the raceway.

Speed in working—because the (original) interwoven wall of DURADUCT keeps the inside of the tube just the same shape as the outside. If the outside of the tube is nice and round, you can bet the inside is the same way—there is no inner lining to cave in and block the raceway.

And besides—if you should happen to step on DURADUCT and flatten it out, you can press it back into shape by mere pressure of the fingers.

All of these features go to make more **Speed.**

Made by

Tubular Woven Fabric Company

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Pacific Coast Representatives

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455 Second St.	532 First Ave. So.	340 Azusa St.	53 Fourth St.

EDITORIAL

Welcome N. E. L. A.

WELCOME, members of the National Electric Light Association, welcome to San Francisco, the Pacific Coast and the West! Although on several past occasions it has been the privilege of Western cities to entertain the N.E.L.A., this is the first time since the Panama-Pacific Exposition that San Francisco has been accorded that honor, an honor of which every citizen is justly proud.

IN considering the tradition built up by a background of hundreds of years about the great cities of the Atlantic Coast, or of the thousands of years behind the cities of the old world, it would seem trite to refer to the mere span of some seventy-seven years that have elapsed since the discovery of gold in California by Marshall in 1848 as history, yet, in actual accomplishment contributing to the economic welfare and social happiness of its citizens, San Francisco has done its bit, and more.

IT is a far cry from the cradle and Long Tom of the placer miner, the covered wagon of the Argonauts of 1849, the hectic days of the vigilantes, and the adventurous episodes chronicled by Bret Harte and Mark Twain, to the modern city that has risen from the ashes of the great disaster of April 18, 1906. Nevertheless, in the courage and fortitude that have built this city, equipped it with every convenience and device known to modern science, is found an example of what we are pleased to regard as the best of American character.

HERE is a land, developed first by those responding to the lure of gold, whose descendants have stayed and found in the countless other natural resources a veritable storehouse filled with riches bounteously bestowed by Nature. Each year, as development progresses farther and farther, new wealth is added, and the prospects of Californians in general and San Franciscans in particular become greater and greater in opportunity for useful service.

AND of all these opportunities, what is greater than electricity? It enters into the daily lives of millions of people, not merely the urban population, but the suburban and rural as well, and this to a degree not paralleled anywhere else in the world.

HERE in California is a physiographic situation unique in its peculiar adaptability to the development of electricity and its practically universal application to the nth degree. The great central valleys of the Sacramento and the San Joaquin take the form of a great elongated oval, enclosed by the Coast Range and Sierra Nevada. These mountains are vast storehouses for the winter snows and provide catchment areas admirably adapted to water storage and its application to hydroelectric power development. The concentration of urban population at the seacoast necessitates the transmission of electrical energy two hundred miles and more, the lines traversing the great central valleys where agriculture prevails, thus bringing right to the door of the farmer the blessing of electrical service in no less degree than that afforded to the city dweller.

THERE is no coal; fuel oil is costly and at other disadvantages compared to electricity. Is it any wonder that California leads the world in the consumption of electricity per capita for every class of application and for every class of consumer?

CONDITIONS affecting the design of apparatus and the transmission of electricity are unique in this state; thus a practice peculiar to California and the West has been developed. To the discussion of these local peculiarities this issue of the Journal of Electricity has been devoted.

IN a few words, from a technical standpoint California has contributed to the world of electricity the greatest example of interconnected power transmission systems in the United States, the development of high-head hydroelectric power, the Pelton impulse turbine, and high-tension power transmission up to 220 kilovolts; from an economic and social standpoint, the inception of the so-called "customer-ownership" idea by which through the purchase of utility stocks on the broadest possible plan of distribution, true public ownership without sacrifice of private initiative and efficiency in operation has become an accomplished fact.

STUDIES of these interesting developments are set forth in this issue. They have been prepared especially for the edification of the members of the National Electric Light Association, in the hope that the data set forth may be of practical benefit to them in helping to solve their own problems.

THE electrical industry of San Francisco, of California, and of the entire West extends a hearty welcome to its guests, and bids them Godspeed in the pursuit of their objective—the constant improvement of electrical service and its continued extension throughout the land.

BIG Creek No. 2, one of the pioneers of the Big Creek-San Joaquin hydroelectric project of the Southern California Edison Company. A fourth generating unit of 17,500 kva. recently placed in operation brings the capacity of this plant to its ultimate. Plans contemplate a second plant here later.

What the N. E. L. A. Convention Means to the Pacific Coast

By Franklin T. Griffith
President National Electric Light Association

Franklin T. Griffith

THE convention of the National Electric Light Association to be held in San Francisco, June 15-19, presents opportunities for the further development and progress of the electrical industry on the Pacific Coast which we, who are so closely identified with it, should not overlook. In turn, we may, perhaps with pardonable pride, express the conviction that our eastern brethren in the industry will undoubtedly find here on the Coast many things worthy of their deepest study.

As delegates to this convention, will come many distinguished visitors who are not only the recognized leaders in the electrical industry but who also are identified with widespread commercial and industrial activities throughout the United States. The gospel which we as hosts convey to these gentlemen will be spread effectively and widely over the entire country. We may well now pause and take note of the potential possibilties of our Pacific Coast states and be prepared to proclaim them properly.

Our Pacific Coast states abound in opportunities for further developments in agriculture, timber, industry and commerce. Favorable climatic conditions, abundance of natural resources, the greatest supply of potential hydroelectric power in the country, adequate transportation facilities by rail, water and magnificent state highway systems, all are factors which, present in abundance in this vast empire, must of necessity make for great opportunities and progress in all fields of endeavor. Let us demonstrate and proclaim these factors at this fitting opportunity. The returns will come back to us manyfold. We know it to be an established fact that the East is looking to the West for attractive capital outlets, and it is to our vital interest to enable these gentlemen to get acquainted with every substantial resource this Pacific Coast affords, to the end that they may be equipped to advise their business, financial and industrial associates in the East of what the Far West has to offer.

The progress made in developing the electrical industry here on the Coast in the past ten years is indeed worthy of attention and study by our eastern brethern and they will, no doubt, find much here to inspire and direct their future efforts. Here they will find hydroelectric developments which in the vastness of their extent and the technical details of their accomplishments are nowhere excelled. They will find the latest pioneering in laboratory and field in the high-voltage transmission of electrical energy and the most comprehensive and extensive interconnection of transmission networks. They will find the widest distribution and utilization of electricity in urban, suburban and rural districts of any territory in the country.

The Pacific Coast early became the cradle of a widespread and vicious movement toward municipal and state ownership of public utilities. Here this movement gained its strongest foothold and it is indeed appropriate that here should arise the most effective plan for its defeat. I refer to the customer-ownership plan which, initiated eleven years ago, has now gained such headway that on three recent and notable occasions, two in California and one in Washington, public ownership was dealt a blow at the polls from which its recovery will be long delayed.

The convention of the National Electric Light Association at San Francisco thus presents opportunities of mutual benefit to the East and West. Let us of the West not overlook these opportunities and above all let us not fail in our pleasures and obligations as hosts.

Hydroelectric Construction and Progress to Meet Growing Power Demand

By W. D. Shaw
Southern California Edis on Company, Los Angeles

WHILE the Southern California Edison Company has sixteen water-power plants totaling over 75,000 kw. and independent of its Big Creek system, it is this latter network of hydroelectric plants that has commanded the attention of the world. That this should be true is not hard to understand when one stops to consider the gigantic magnitude of the ultimate development, the daring and untried engineering procedure which has since become standard practice and the increase and success of this system since its inauguration.

As is well known, the Big Creek system derives its name from a tributary of the San Joaquin River. The first two power plants known as Big Creek No. 1 and No. 2 are located on this stream about seventy-five miles northeast of Fresno and were built in 1913. Two 30,000-kw. generators were installed initially in each power house, but at the present time Big Creek No. 1 has a total of 78,000 kw. and Big Creek No. 2 a total of 70,000 kw.

In order to supply and control the water necessary for these two power plants, a reservoir known as Huntington Lake was constructed. This lake has a capacity of 88,000 acre-ft., is 4.5 miles long by 0.75 mile wide and is fed by a drainage area of 79 sq. miles.

As the market for the power to be generated was 240 miles distant and as this was beyond the limit at which power economically could be transmitted at the voltages then in use, it was necessary to blaze the way and go to untried voltages and engineering methods. The pressure selected was 150 kv. and synchronous condensers were installed to maintain a constant voltage. Needless to say, both experiments proved successful and history was made in the art of electrical transmission.

After the completion of this first installation, extensive studies were made and a comprehensive plan outlined for the ultimate development of what is now the Big Creek system. Present plans show that an ultimate of about 1,100,000 kw. can be obtained and will call for the buildiing of a score of power houses fed by more than a dozen reservoirs capable of storing a total of nearly 750,000 acre-ft. This would conserve the water from a drainage area of over 1,200 sq. miles.

Consistent with this general program, the next station to be built would have been Big Creek No. 3 which, by means of impulse wheels, could have utilized a drop of 1,545 ft. after the water left Big Creek No. 2. However, due to the extreme urgency for power in 1920, it was decided to take advantage of about one-half of this head by means of reaction turbines and complete a power plant known as Big Creek No. 8. This was done in the record time of fifteen months and a single unit of 22,500 kw. was installed.

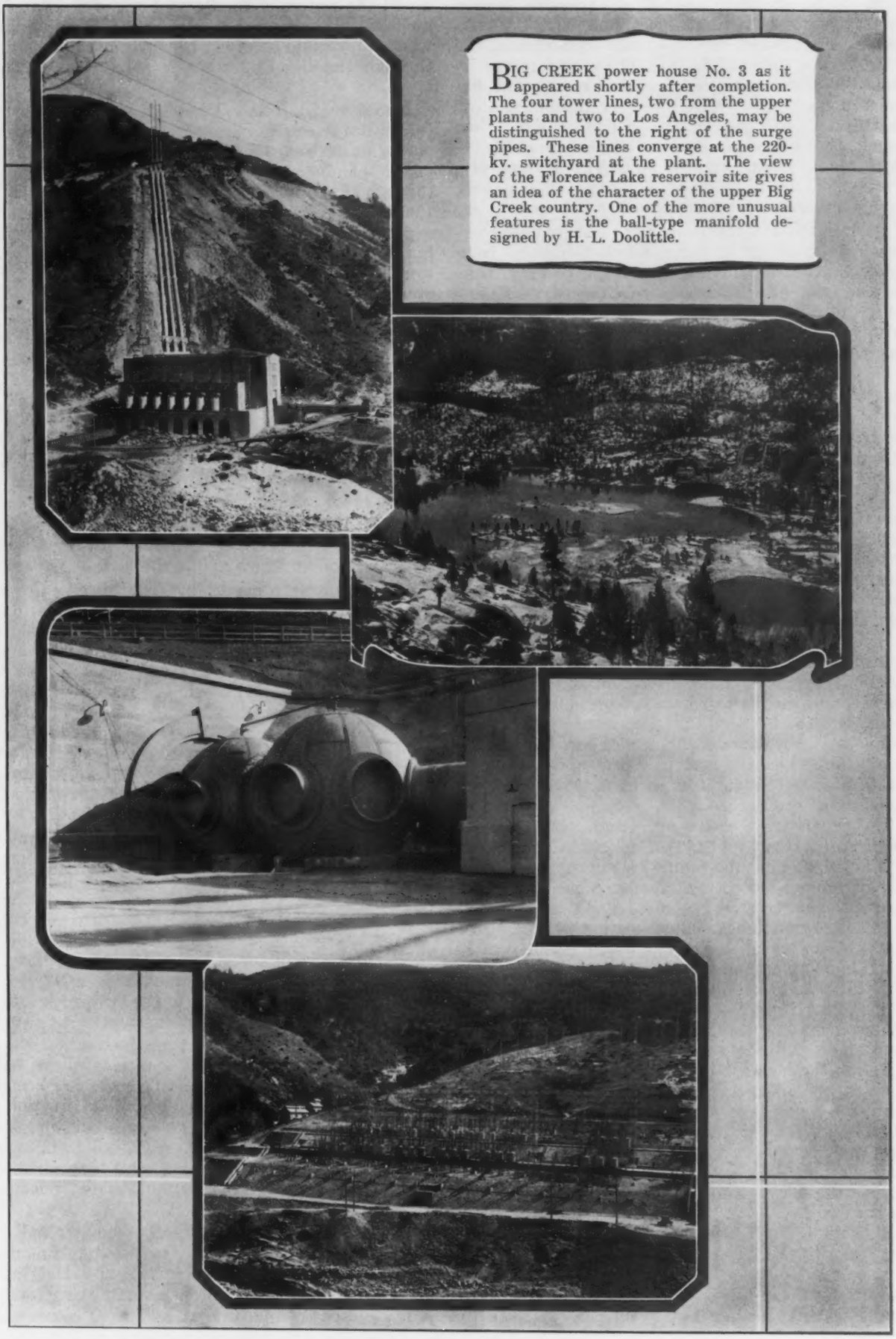
No sooner was Big Creek No. 8 completed than preparations for the construction of Big Creek No. 3 were started. This is the largest hydroelectric power plant in the West, and will have an ultimate capacity of 163,000 kw. It is located at the junction of Mill Creek and the San Joaquin River six miles below Big Creek No. 8, using all the water in the San Joaquin River plus the amount released from Huntington Lake and passing through power plants Nos. 1, 2 and 8.

There is a diversion dam across the San Joaquin River 150 ft. high and 485 ft. long, providing storage capacity sufficient to carry the present installation of 82,500 kw. for a period of 7.75 hours. A tunnel 30,000 ft. long and having a capacity of 3,000 sec. ft. conducts the water from the diversion dam to the penstocks. The intake for this tunnel is a reinforced concrete structure 115 ft. high, with a cylindrical gate 22 ft. in diameter and 90 ft. high. This gate is motor-operated and hydraulically balanced.

One of the odd features of this installation is the surge chamber, on account of its peculiar shape. This chamber is cut out of solid rock and takes the form of a mammoth hour glass 200 ft. high. The bottom diameter is 60 ft. and the top diameter 78 ft., and these two chambers are connected by a shaft 26 ft. in diameter. The large sections provide for load suddenly applied. Any surge caused by the sudden shutting down of the machines in the power house will be taken care of by allowing the water column to rise and fall in the upper chamber. The center line of the surge chamber is offset 48 ft. from the center line of the tunnel in order to facilitate construction.

Another outstanding feature of this installation is the peculiarly shaped manifold used to form the transition from the 18-ft. pipe leading out of the tunnel to the six penstocks which are 7.5 ft. in diameter.

Due to the high head and large diameter, it was not practicable to use the ordinary branch fitting type of manifold because there would have been unbalanced stresses around the outlets to the penstocks that would have been impossible to take care of satisfactorily. To overcome this difficulty a manifold was designed consisting of two 24-ft.-diameter spheres made from $\frac{5}{8}$-in. steel plate. These spheres are connected by a short section of 15-ft. piping. To one of these spheres the 18-ft. pipe to the tunnel and two penstocks connect, while the other sphere provides connection for the remaining four penstocks. The advantage of the spherical design is that the only



BIG CREEK power house No. 3 as it appeared shortly after completion. The four tower lines, two from the upper plants and two to Los Angeles, may be distinguished to the right of the surge pipes. These lines converge at the 220-kv. switchyard at the plant. The view of the Florence Lake reservoir site gives an idea of the character of the upper Big Creek country. One of the more unusual features is the ball-type manifold designed by H. L. Doolittle.

force to be provided against is excessive tension around the outlets that is overcome easily by reinforcing rings placed on the outside of the pipes.

There are three 27,500-kw. 11-kv. generators installed in power house No. 3 at the present time, but the ultimate capacity calls for six machines. The unit system has been carried a little further than usual. Two generators and one bank of three 18,500-kva. transformers form one unit. This eliminates a low-tension bus, reduces high-tension switching equipment and saves on transformer unit cost.

Each bearing of the main units has its own gear-driven lubricating oil pump which forces oil from below the bearing to the top of the bearing, thus keeping the oil circulating continuously. Motor-driven oil pumps are installed for starting and are arranged to start automatically in case a gear-driven pump should fail.

Generators and transformers are protected by differential relays which, under severe conditions, open the high and low-tension circuit breakers, open the generator field and close the wicket gates of the turbines, thereby shutting down both generators.

Big Creek No. 3 is of peculiar interest because it is the first power plant built for straight 220-kv. operation. The 220-kv. switch rack covering over 80,000 sq. ft. is several hundred feet from the power house, and the present capacity takes care of four line positions and two transformer positions. It is of double-bus design, and the main buses are made of 4-in. standard iron pipe supported by insulated piers.

Big Creek No. 3 is the strategic and controlling unit of the Big Creek system of hydroelectric plants due not only to its physical location at the extreme lower end of the major portion of the entire development, but to the fact that the transmission lines from the upper plants come into its buses. In other words the generating system above this plant is almost an entirely separate unit as far as the rest of the system is concerned.

The change-over of the operating voltage of the Big Creek system from 150 kv. to 220 kv. took place in May, 1923, and was brought about by the necessity of having more transmission capacity to take care of the power to be generated at Big Creek No. 3.

By intensive studies and calculations it was found that 220-kv. transmission was possible and that it would be more economical and much quicker to convert the two 150-kv. lines to the higher voltage than to build duplicate lines for 150-kv. operation. In either case the transmission capacity would be doubled.

Due to the increase in the legal distance required between conductor and ground it became necessary to raise the height of many of the towers from 5 to 20 ft. in order to get the required clearance. As the lines could not be taken out of service for any but very short periods, it was found necessary to raise most of the towers while the lines were in full operation at 150 kv.

Back in 1920, before the starting of Big Creek No. 8 or Big Creek No. 3, plans had been made and work started on one of the most imposing single projects that the Edison company has undertaken. This was the Florence Lake tunnel which was to divert the waters of the South Fork of the San Joaquin River, bringing them down to Huntington Lake where they could be utilized for power while passing through the Big Creek power plants Nos. 1, 2, 8 and 3.

It took nearly four and one-half years to build the tunnel but it will increase the output of the present plants by 250,000,000 kw-hr., and when the future power plants are completed the waters coming through Florence Lake tunnel will produce over 1,250,000,000 kw-hr. The tunnel is 13.5 miles long with a height and width of 15 feet. It is the longest tunnel of its bore in the world and likewise holds the world's record for monthly, weekly and daily progress. During one week a record of 174 ft. was made, or more than 1 ft. per hour through solid granite.

While the straight line between Florence and Huntington Lakes is only 11 miles, it was thought advisable to lay out the tunnel in three sections. This added 2.5 miles to the total length, but by increasing the available working headings from two to six it was estimated that a saving of two years could be made in the total time to complete the tunnel. By fitting the equipment to the conditions and operating in the most efficient manner the job was completed one year in advance of the original estimate.

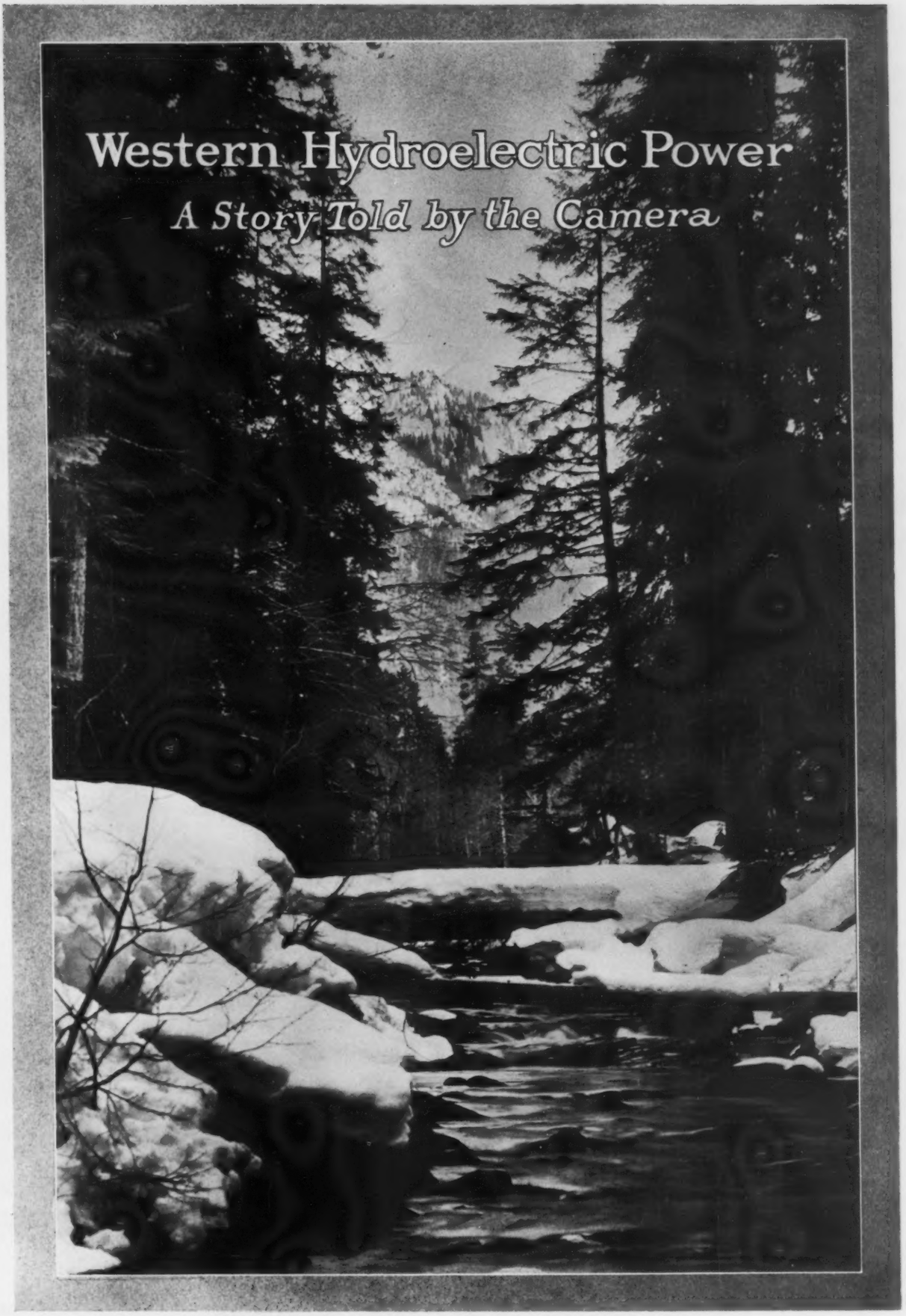
Some of the contributing factors by which efficiency was obtained may be mentioned:

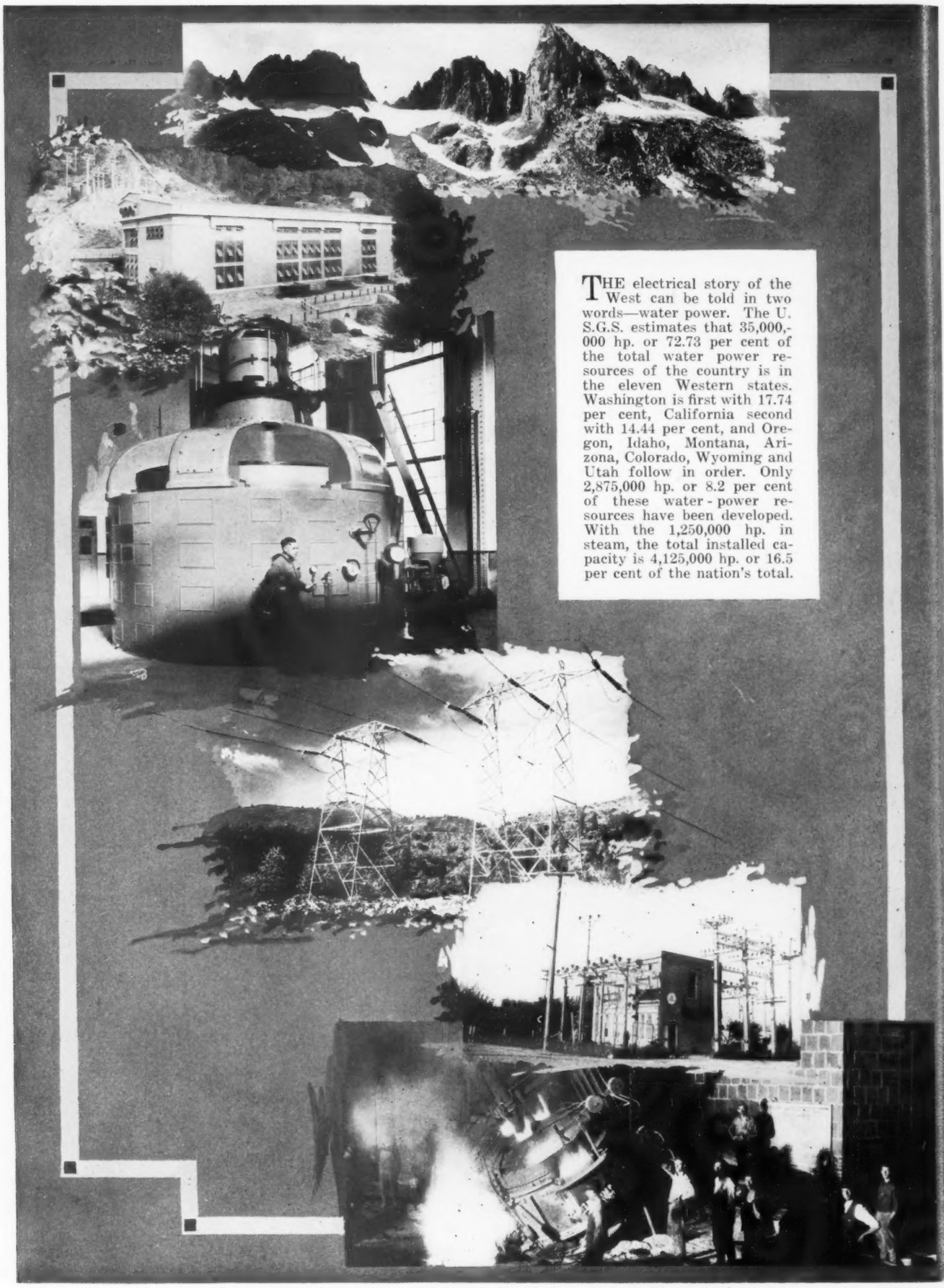
Steam shovels operated by compressed air were used for mucking; large dump cars of from 4 to 6 cu. yd. capacity replaced smaller ones; and combination storage-battery and trolley-type locomotives made possible larger loads. A 24-in. wood-stave pipe for ventilation was easy to repair and permitted the use of larger blowers which cleared the tunnel of powder gases in a short time. Discoveries and improvements in powder and dynamite increased the force and reduced the gases. Drilling tools were improved and lengthened, making possible the wonderful records in progress.

In order to accomplish this enormous amount of construction work it has been necessary to inaugurate a standing army of construction men on a permanent basis. The active front of construction and development work during the last five years has covered an area 72 miles long and 32 miles wide, a territory of virgin forests and lofty mountains accessible only by steep and narrow trails. Road-building has proved to be one of the best by-products of the art of hydroelectric development.

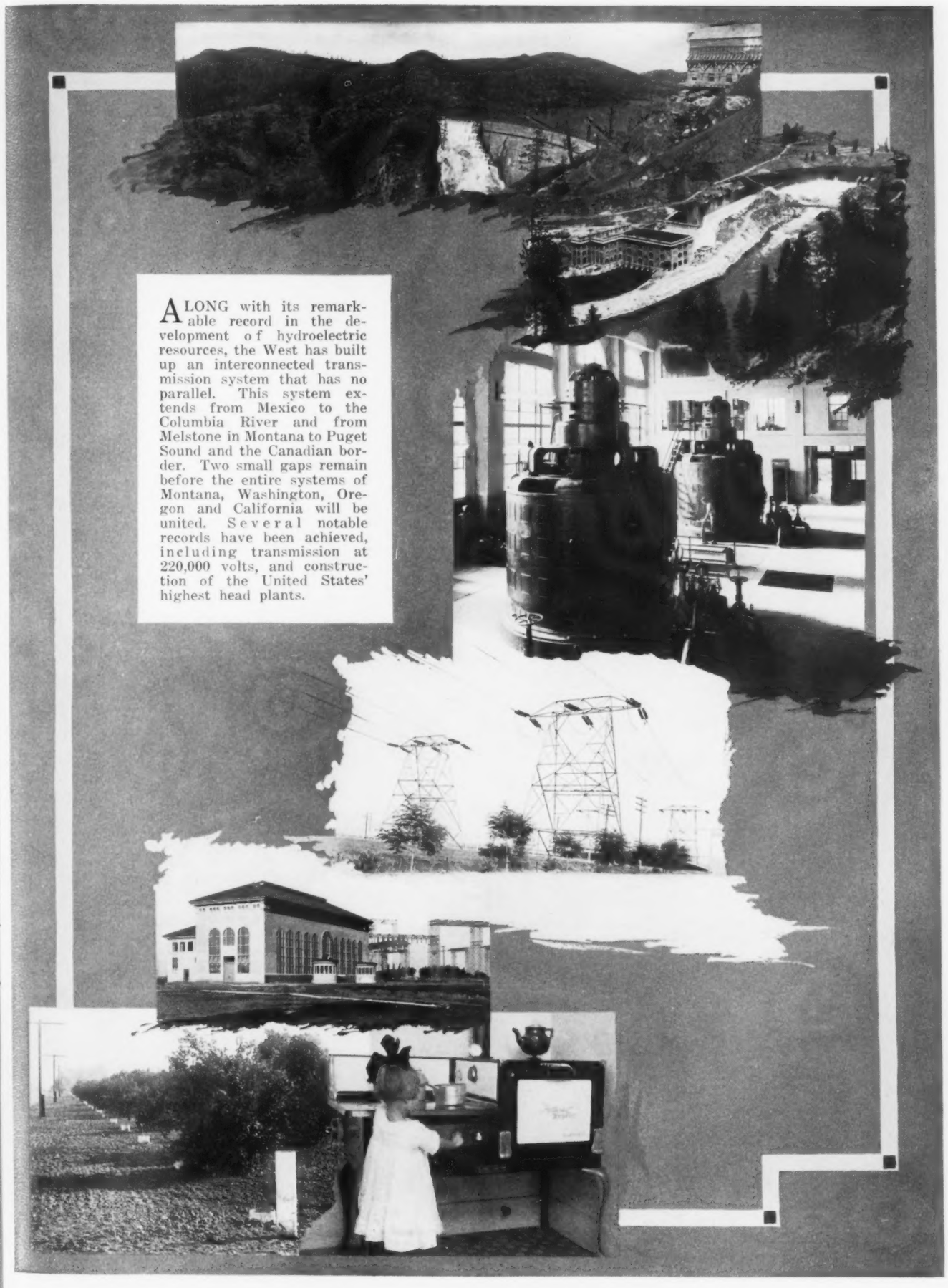
Coincident with the great production of water power was the necessity of supplementing it with steam power. As a consequence, a large steam plant was erected at Long Beach and placed in operation in December, 1924. This is the largest steam plant west of the Mississippi River. It uses high-pressure superheated steam, has the last word in modern appliances, and obtains an exceptionally high efficiency of operation.

While the achievements have been many and the progress rapid since the Big Creek system was conceived, the increased demand for more and more power necessitates continued planning and effort to meet the needs of the future.


Western Hydroelectric Power
A Story Told by the Camera

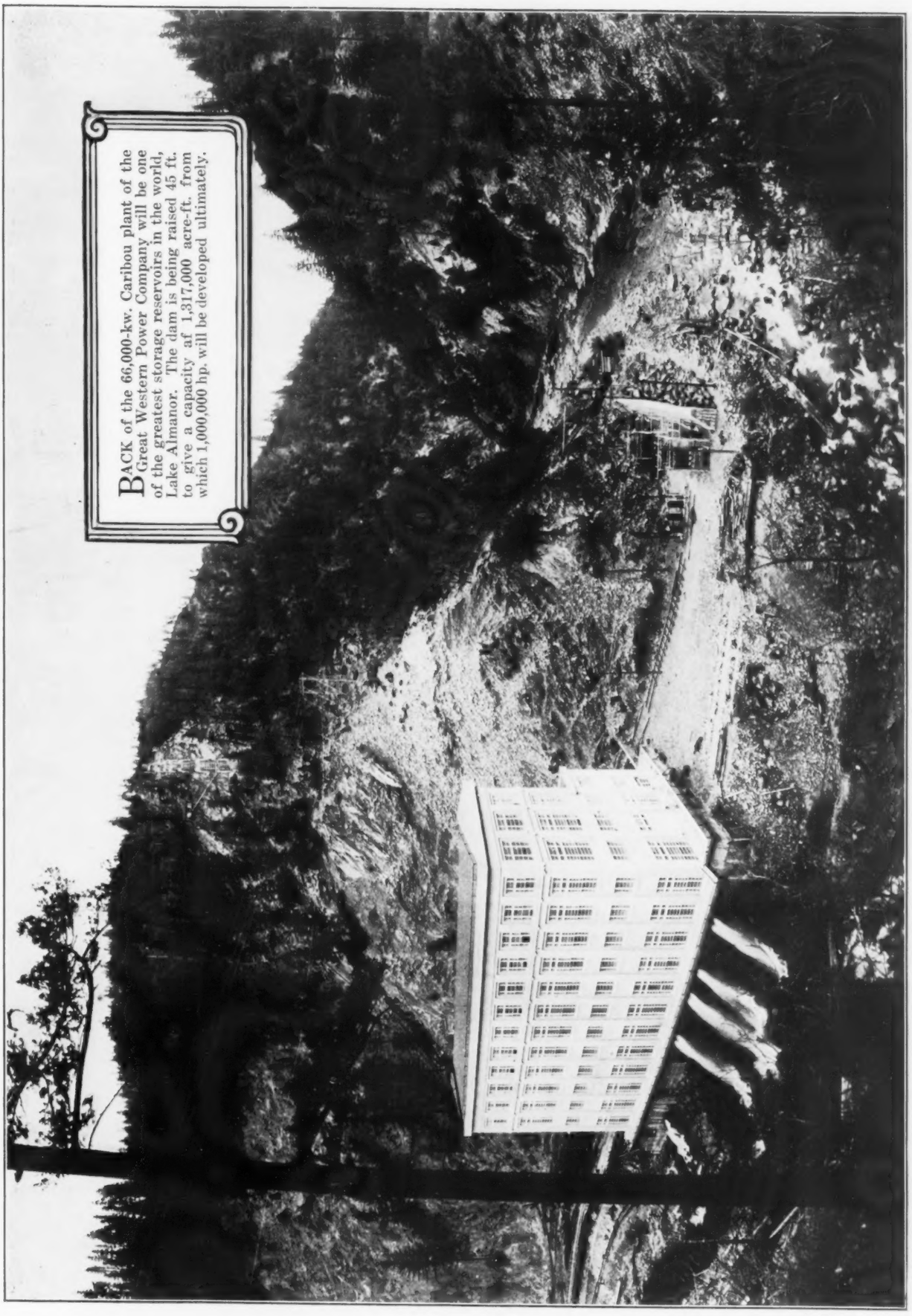


THE electrical story of the West can be told in two words—water power. The U. S.G.S. estimates that 35,000,000 hp. or 72.73 per cent of the total water power resources of the country is in the eleven Western states. Washington is first with 17.74 per cent, California second with 14.44 per cent, and Oregon, Idaho, Montana, Arizona, Colorado, Wyoming and Utah follow in order. Only 2,875,000 hp. or 8.2 per cent of these water-power resources have been developed. With the 1,250,000 hp. in steam, the total installed capacity is 4,125,000 hp. or 16.5 per cent of the nation's total.

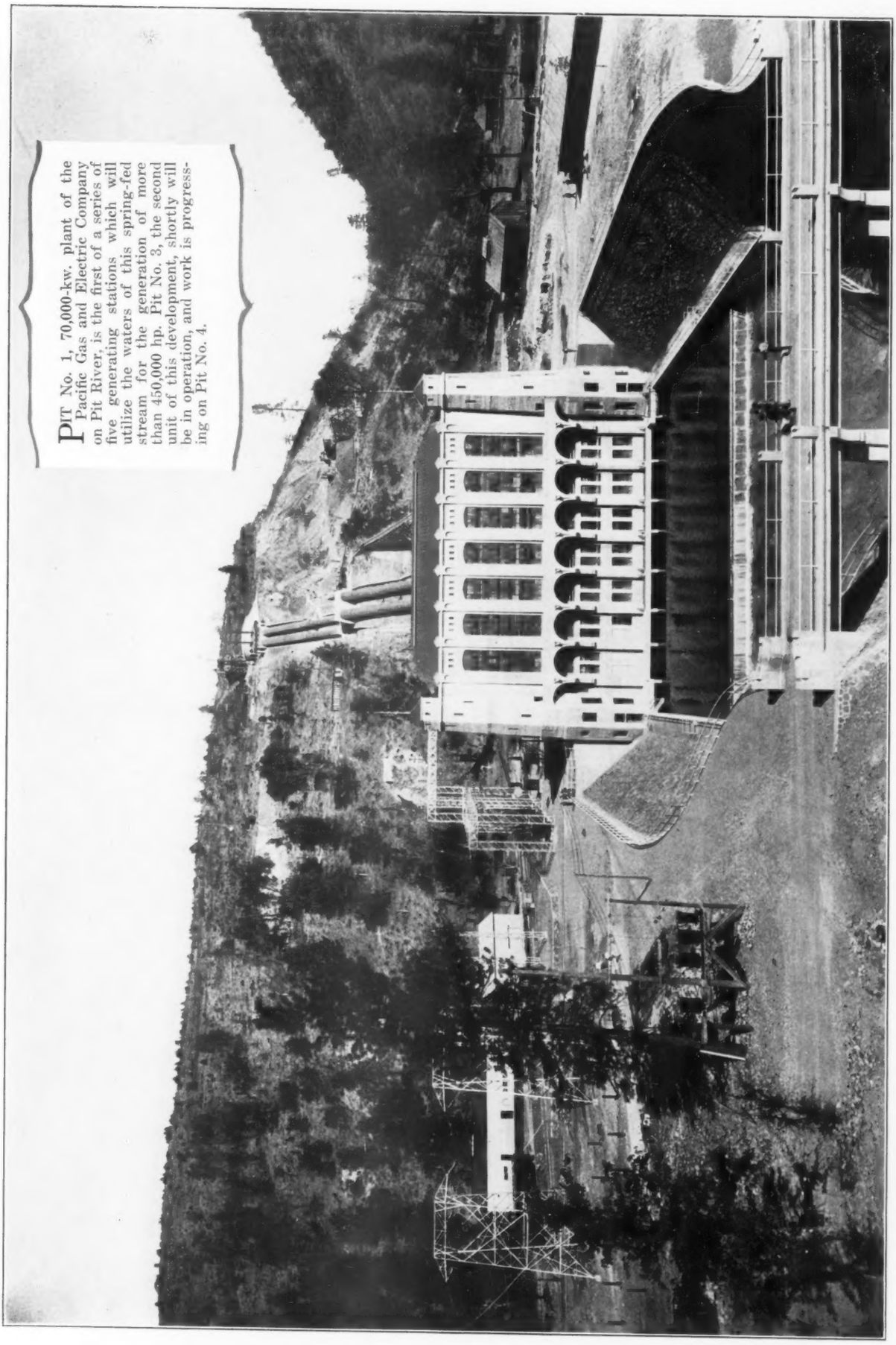


ALONG with its remarkable record in the development of hydroelectric resources, the West has built up an interconnected transmission system that has no parallel. This system extends from Mexico to the Columbia River and from Melstone in Montana to Puget Sound and the Canadian border. Two small gaps remain before the entire systems of Montana, Washington, Oregon and California will be united. Several notable records have been achieved, including transmission at 220,000 volts, and construction of the United States' highest head plants.

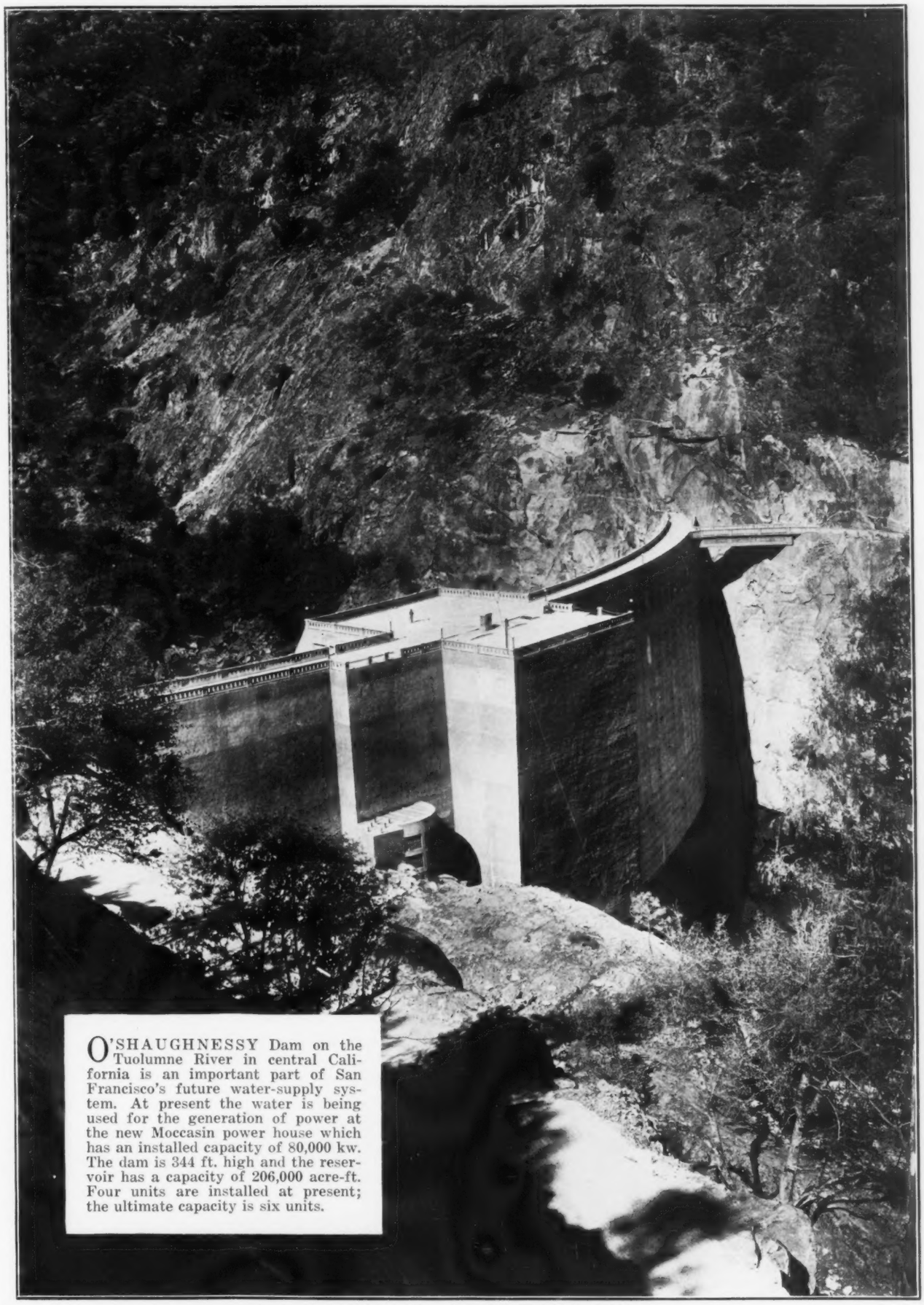
WONDERFUL changes have occurred in the 35 years of hydroelectric progress in the West. Here the two extremes, the Rome plant built in the late nineties, and the Big Creek No. 1, one of the modern installations.



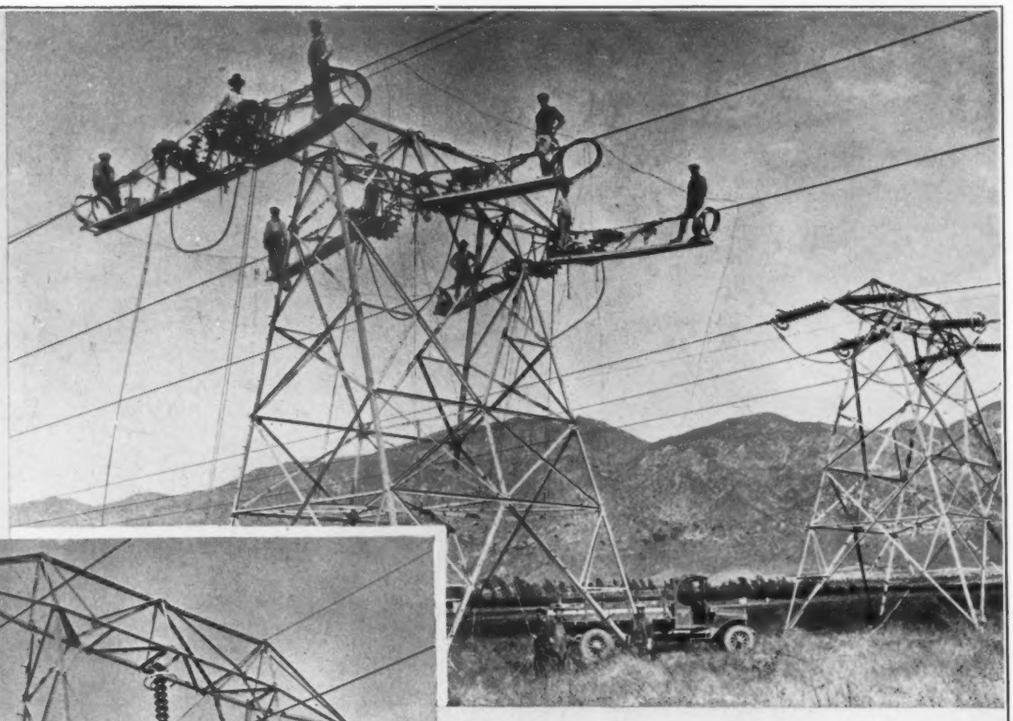
BACK of the 66,000-kw. Caribou plant of the Great Western Power Company will be one of the greatest storage reservoirs in the world, Lake Almanor. The dam is being raised 45 ft. to give a capacity af 1,317,000 acre-ft. from which 1,000,000 hp. will be developed ultimately.

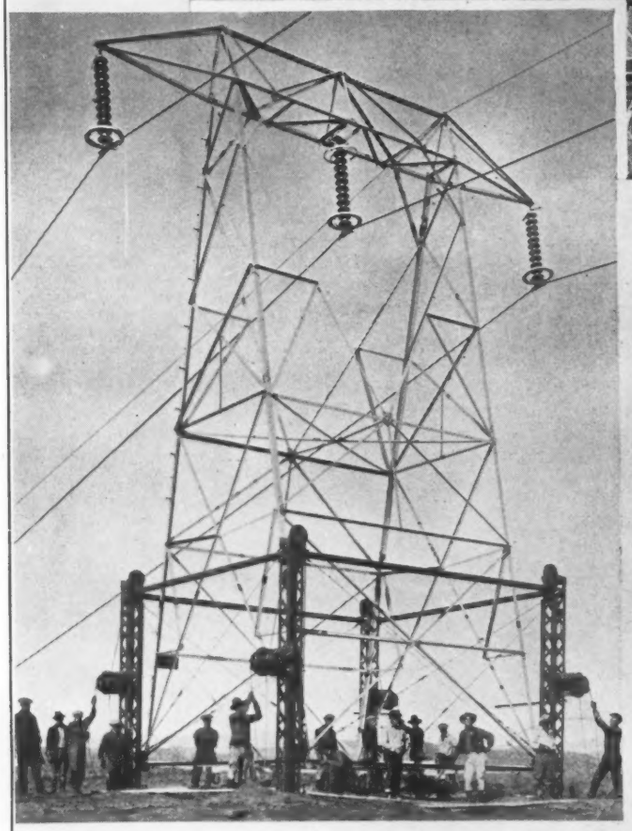


PIT No. 1, 70,000-kw. plant of the Pacific Gas and Electric Company on Pit River, is the first of a series of five generating stations which will utilize the waters of this spring-fed stream for the generation of more than 450,000 hp. Pit No. 3, the second unit of this development, shortly will be in operation, and work is progressing on Pit No. 4.

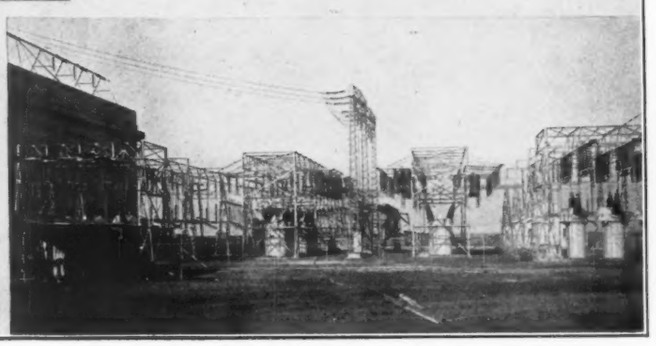


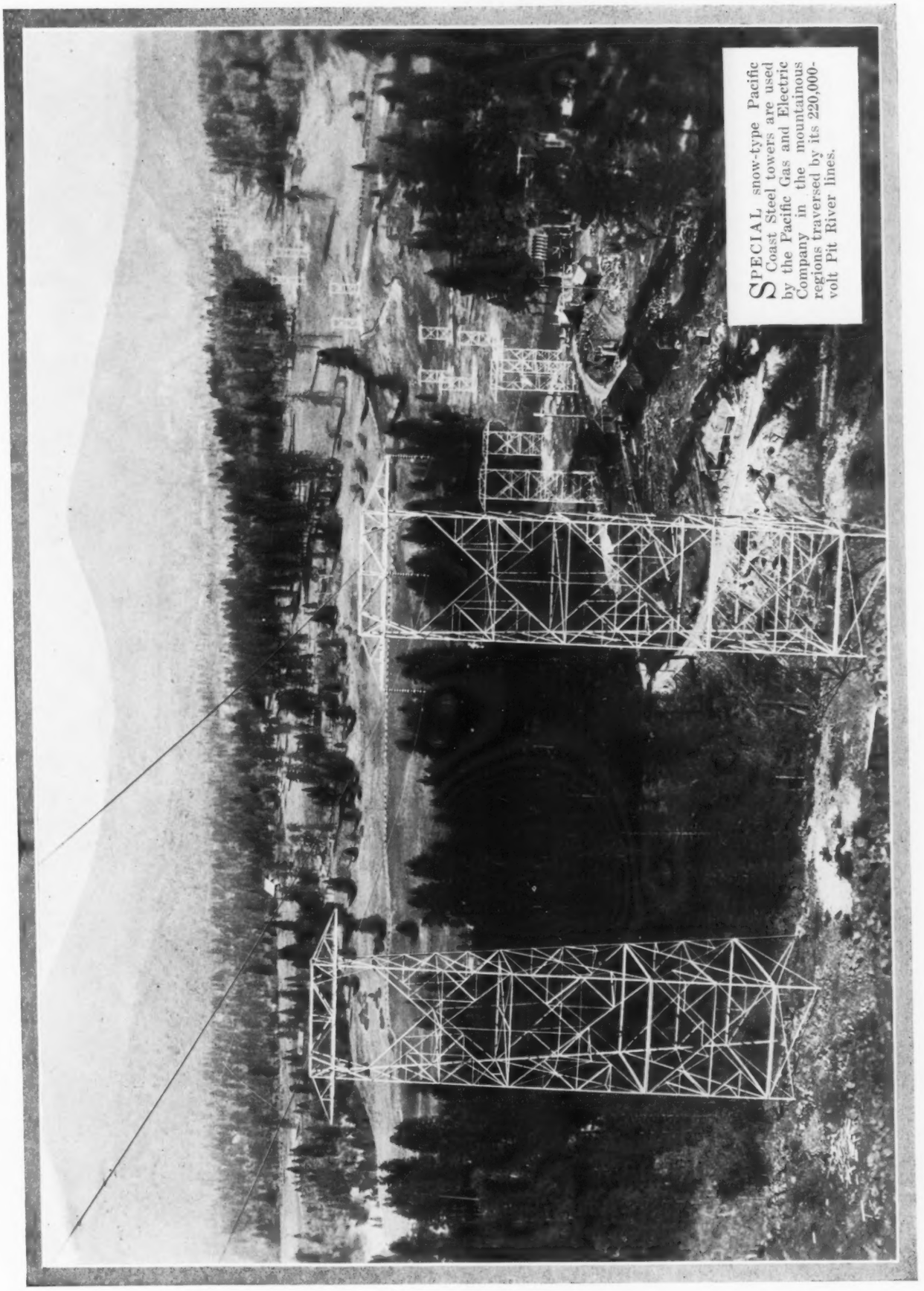
O'SHAUGHNESSY Dam on the Tuolumne River in central California is an important part of San Francisco's future water-supply system. At present the water is being used for the generation of power at the new Moccasin power house which has an installed capacity of 80,000 kw. The dam is 344 ft. high and the reservoir has a capacity of 206,000 acre-ft. Four units are installed at present; the ultimate capacity is six units.



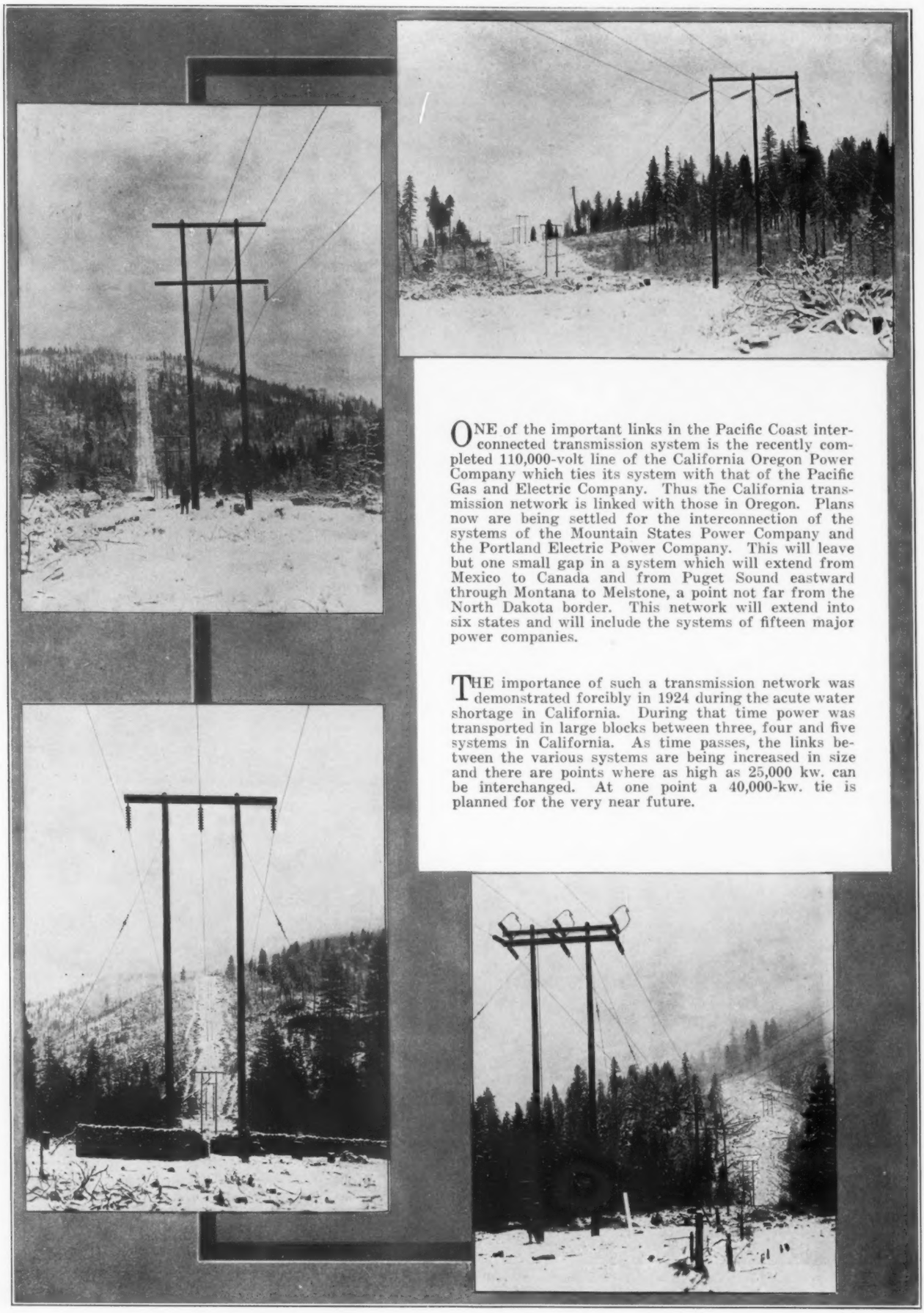


WHEN the Southern California Edison Company increased the voltage of its Big Creek lines from 150,000 to 220,000 volts, the existing towers were raised to provide greater clearance. Sections of one circuit of the twin-circuit line were taken out of service, re-insulated and the towers raised. This company was the first to use 220,000 volts commercially. At the present time it is planning the construction of an additional line of this capacity from its Big Creek plants to Los Angeles, and will start work this summer. Ultimately the Edison company will deliver 1,300,000 hp. from its Big Creek and San Joaquin River plants.



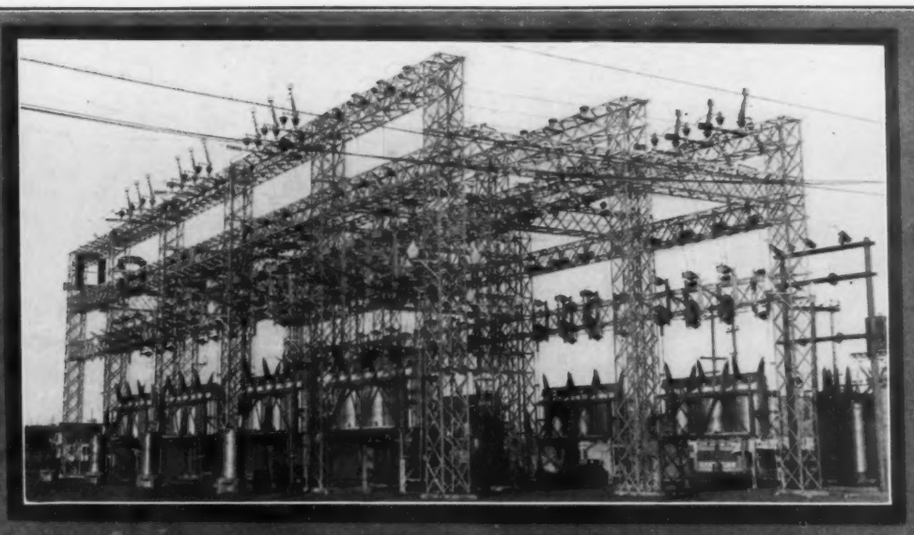


SPECIAL snow-type Pacific Coast Steel towers are used by the Pacific Gas and Electric Company in the mountainous regions traversed by its 220,000-volt Pit River lines.

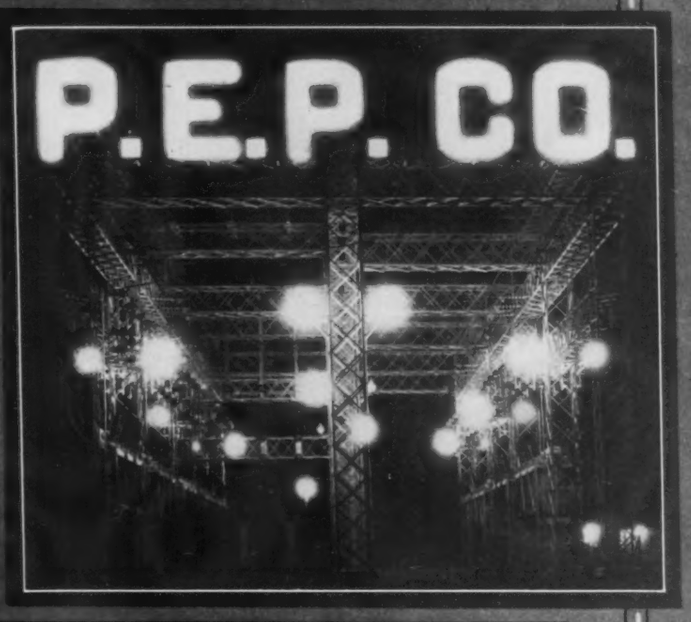


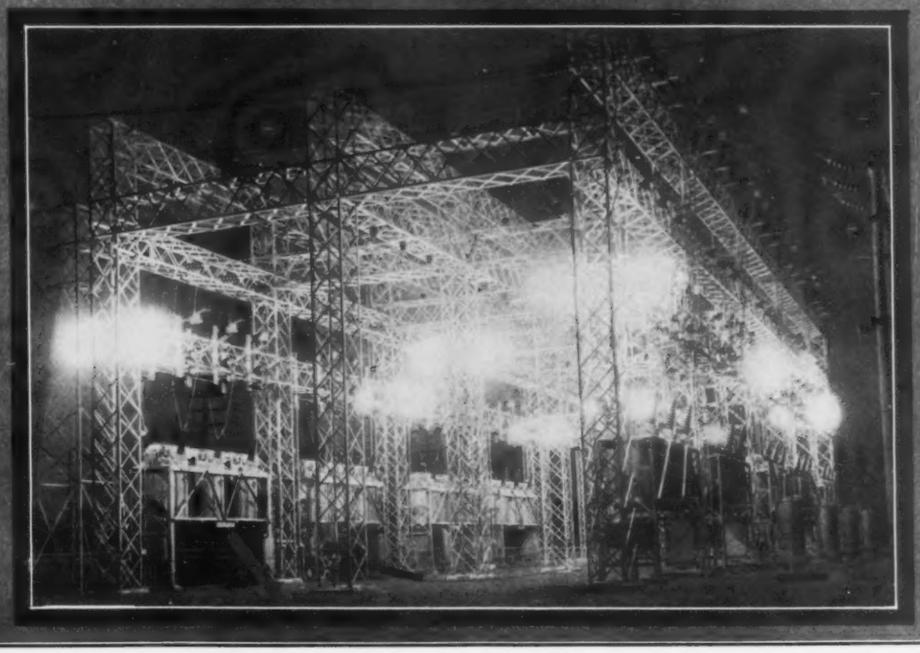
ONE of the important links in the Pacific Coast interconnected transmission system is the recently completed 110,000-volt line of the California Oregon Power Company which ties its system with that of the Pacific Gas and Electric Company. Thus the California transmission network is linked with those in Oregon. Plans now are being settled for the interconnection of the systems of the Mountain States Power Company and the Portland Electric Power Company. This will leave but one small gap in a system which will extend from Mexico to Canada and from Puget Sound eastward through Montana to Melstone, a point not far from the North Dakota border. This network will extend into six states and will include the systems of fifteen major power companies.

THE importance of such a transmission network was demonstrated forcibly in 1924 during the acute water shortage in California. During that time power was transported in large blocks between three, four and five systems in California. As time passes, the links between the various systems are being increased in size and there are points where as high as 25,000 kw. can be interchanged. At one point a 40,000-kw. tie is planned for the very near future.

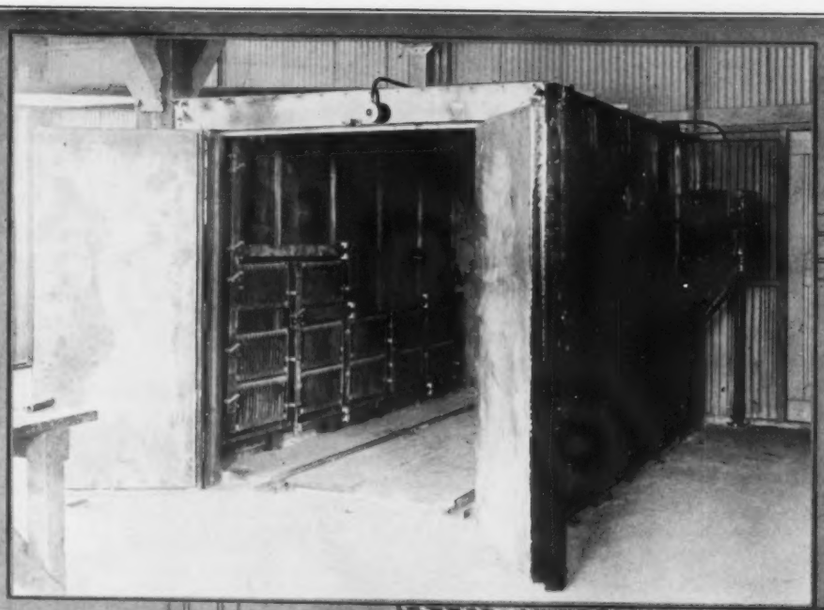


THE trend in Pacific Coast bus construction is toward the outdoor location. This is true for the lower voltages as well as for the higher voltages. Weather conditions of all sorts have been encountered successfully even where the severest kind of conditions are of common occurrence. The cuts shown picture the 60-kv. switching structure at the Lents substation of the Portland Electric Power Company. This station serves as the terminus of the four transmission lines from the River Mill, Cazadero, Bull Run and Oak Grove plants.

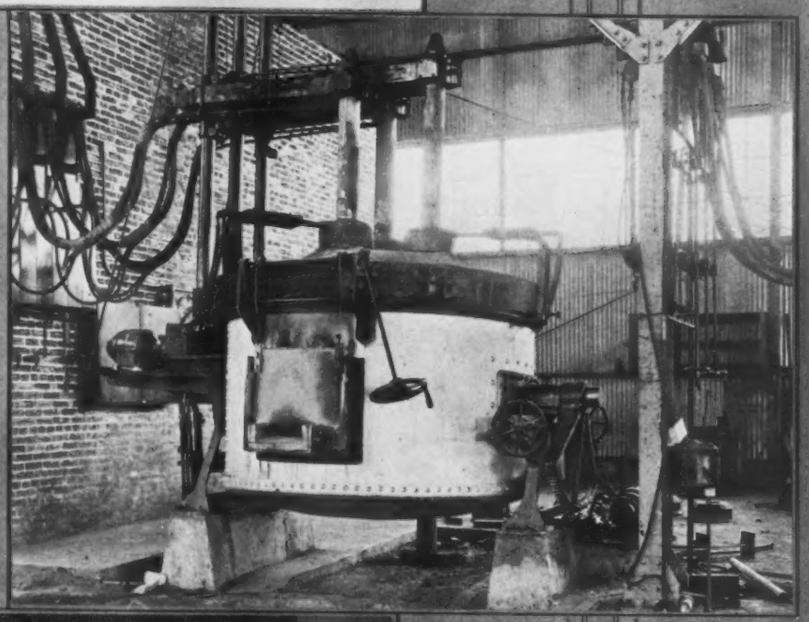




ELECTRICITY plays an important role in the large oil fields of the West. It has been employed successfully for pumping for many years, and considerable success now is being experienced in the drilling of wells with electric motors. There are many oil fields which are electrified completely.

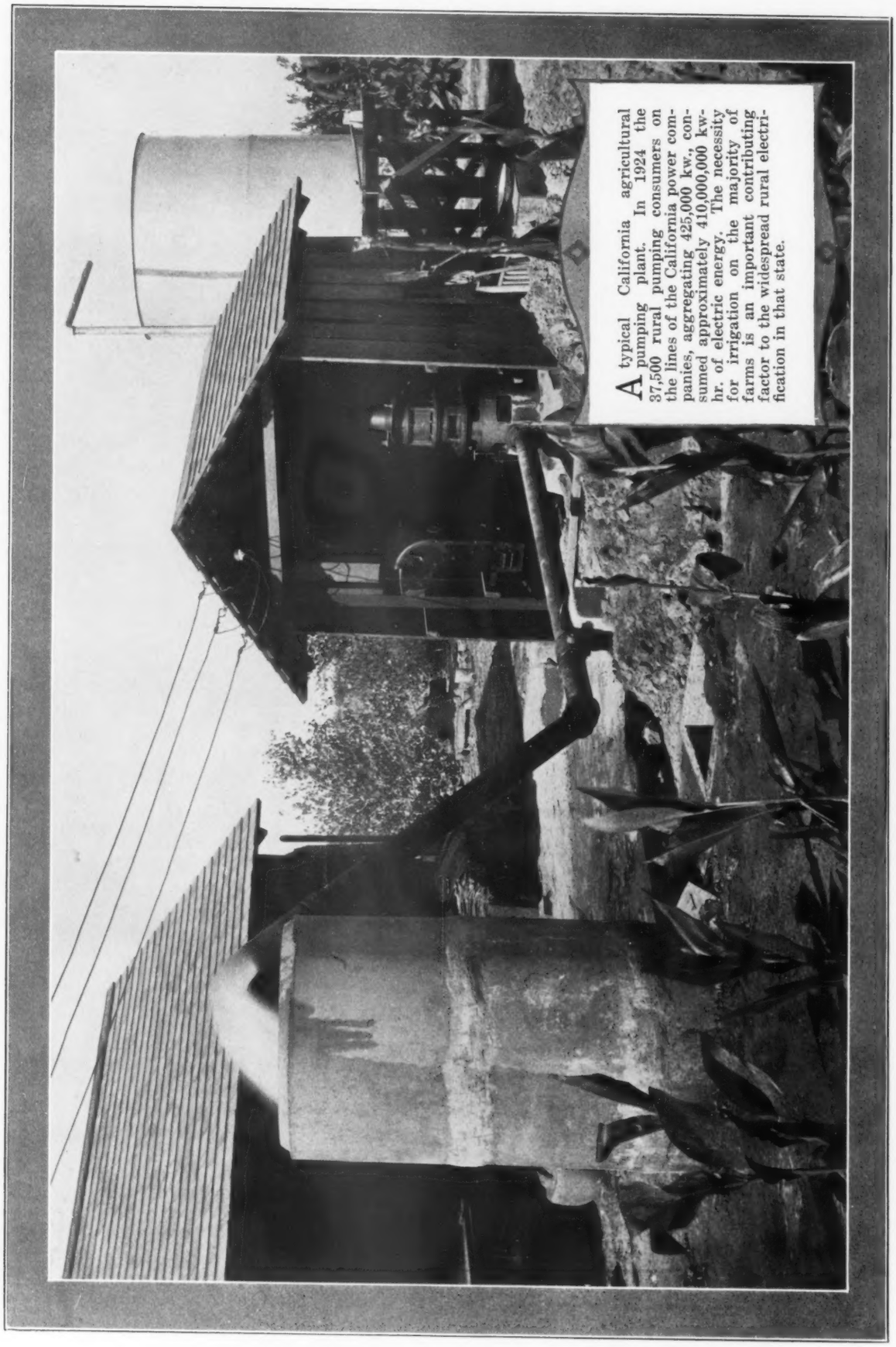


INDUSTRIAL heating is one of the greatest fields for future application of electricity in the Western states. A completely electrified foundry is located in Los Angeles, and there are few cities where there is not at least one electric furnace. There are also many electric ovens of various types.



ELECTRIC cooking and water heating has been developed to such a degree in practically all of the Western states that many companies have one electric range for every seven domestic consumers. California has 21,000 electric range users, Oregon, Washington and Idaho more than this number. One company alone plans to sell 8,000 electric ranges this year.

ELECTRICITY continues to play an increasingly important role in the lumbering industry of the Pacific Coast, not only in the sawmills but in the woods as well. The accompanying two views show an electric yarder on the properties of the Snoqualmie Falls Lumber Company in Washington. Motors of capacities ranging from 300 hp. upward are used in this class of service.



A typical California agricultural pumping plant. In 1924 the 37,500 rural pumping consumers on the lines of the California power companies, aggregating 425,000 kw., consumed approximately 410,000,000 kw-hr. of electric energy. The necessity for irrigation on the majority of farms is an important contributing factor to the widespread rural electrification in that state.

The Interconnected Transmission System of California

By W. G. Vincent, Jr.

Vice-president and Executive Engineer, Pacific Gas and Electric Company

THE network of transmission lines in the West at the present time makes possible, by interconnection, the transmission of power from Vancouver, Wash., to Yuma, Ariz., a distance of about 1,400 miles. The closing of a 30-mile gap between Vancouver and Kalama, Wash., will tie together the Washington-Montana system with that of California and Oregon, so that territory covered will include six western states and extend from the Mexican to the Canadian border. This great interconnected system has grown to its present extent in the short space of twenty-five years; the story of its development in California from the beginning is told in this article.

WITHIN the electrical industry California has won renown for the development of high-head water power plants, the transmission of electrical energy at high voltages, and the application of the technique of high-voltage transmission to the economic distribution of its water powers; and in no phase of the development of the resources of California were there required more vision, courage, resourcefulness, initiative and confidence than in the harnessing and the transmitting of these powers in the form of electricity throughout the length and breadth of the state. The details of the problems encountered, both economic and technical, of the many failures, the long and painstaking research, and the final solutions, make a story that is an outstanding exemplification of that ingenuity and resourcefulness that has been such a potent factor in the development of American industry.

It is the purpose of this article to sketch very briefly from their beginnings, particularly during the past twenty-five years, the growth of the interconnected transmission system that now is operated by the electric utility companies of the state, and to call attention to some basic conditions which have affected this expansion, some of the problems which had to be solved, some of the chief accomplishments, and some of the resulting benefits without attempting to cover either the technical or economic side of the subject exhaustively or in detail.

Physiography

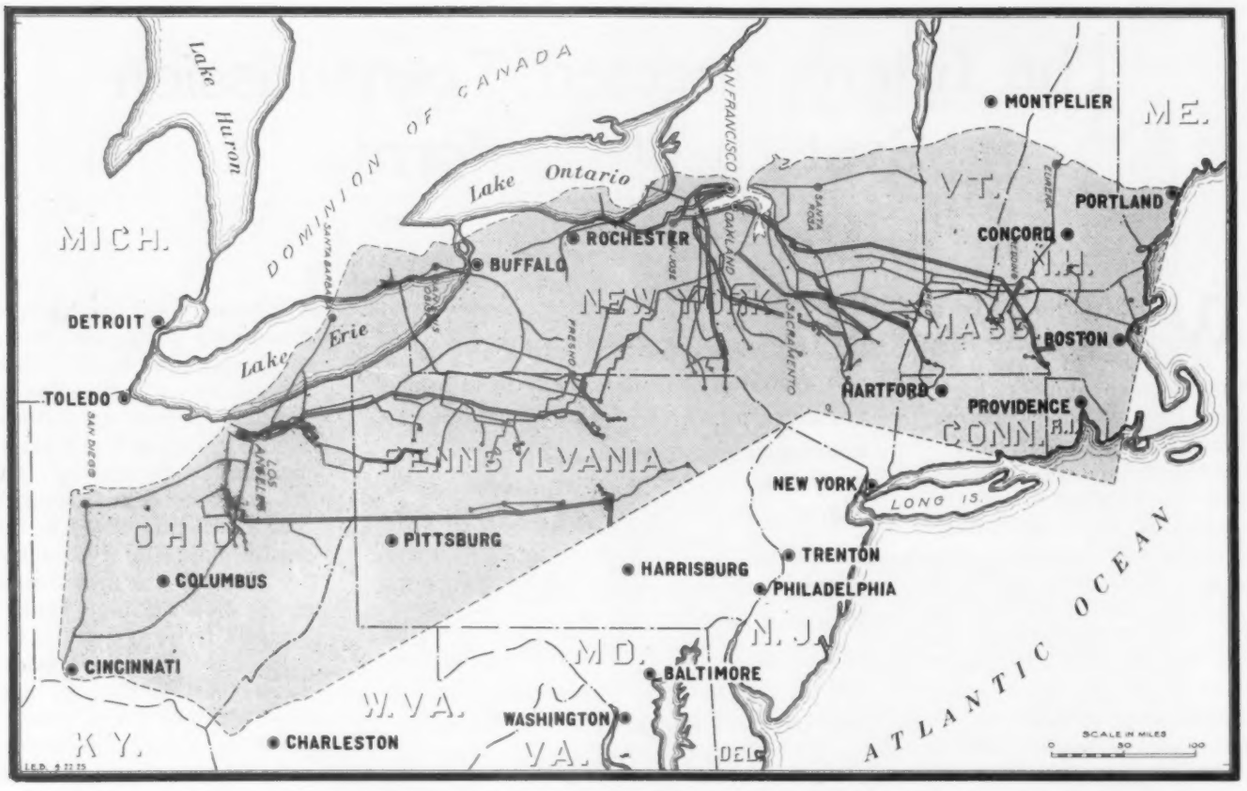
The physiographic geography of the Pacific slope is extremely varied in character and climatic conditions. The winters along the coast and in the great valleys are extremely mild in comparison with those in the same latitude on the Atlantic Coast, in spite of the fact that the forests rise until they meet living glaciers on the higher peaks in the northern mountains and the Sierra which is far-famed for its deep snows. Citrus groves extend as far north as the latitude of the southern boundary of Pennsylvania, and the contrasts in temperature between north and south are correspondingly much less than on the eastern coast. This uniformity of climate is due to prevailing winds bringing inland the nearly constant temperature of the great ocean to the west.

In California there is no coastal plain like that along the Atlantic, the mountains of the Coast Range rising abruptly from the shore, in some cases to elevations above 3,000 ft. East of this range lies the great valley, which is some 500 miles long with a floor of low-lying plains drained by the San Joaquin River from the south and the Sacramento River from the north, joining to enter San Francisco Bay. East of the great valley in the northern part of the state and paralleling the coast line rises the Cascade Range with its imposing Mt. Shasta, and continuing southward in the central and south central part of the state, the Sierra Nevada. Snow-capped peaks with forested slopes dot the entire length of both ranges. East of these ranges and generally east of California extending into Nevada, Arizona and Utah, lies an arid plateau region.

In general, therefore, it may be said that the Pacific slope has four major physiographic areas—namely, the Coast Range, the great valley, the Sierra Nevada-Cascade Range and the arid plateau, all parallel to the shore line and lying across the moisture-laden southwest trade winds, resulting in the winter season in belts of varying rainfalls as these winds come in contact with the Coast Range and Sierra Nevada-Cascade Range and the air currents from the land.

Geographic Comparison

To those who are not familiar with the topography of the Coast and its mountain ranges, the conception of its distances is usually from exaggerated-scale maps in railroad time tables, or from other small-scale maps wherein the comparisons with eastern territories are lost. Few realize that California is 800 miles long and that it has an area of 155,000 sq. miles or three and one-half times that of Pennsylvania. The projection of a few of the west coast



Area and transmission lines of California superimposed on the eastern section of the United States. California cities and transmission lines shown in red

points to the eastern seaboard of the same latitude indicates the distances in terms of places better known.

West Coast	East Coast
Seattle	Gulf of St. Lawrence
Portland	Augusta, Maine
North California line	Boston, Mass.
San Francisco	Richmond, Va.
Los Angeles	Columbia, S. C.
San Diego	Charleston, S. C.
South California line	Savannah, Ga.

The accompanying map superimposing California on the East will assist in a comprehension of the dimensions of the state and the relative distances, and particularly the area covered by its transmission systems.

It will be noted that if an area the size and shape of California were laid out in the eastern section of this country it would include both Portland, Me., and Cincinnati, Ohio. Sacramento would be located near Albany and Los Angeles near Cleveland. The names of California cities are printed in red, and the red lines on the map show the main transmission lines now in operation in California.

Early Problems

The early developments in the science of the use of electrical energy and the development of electric service found California with well developed population centers on tidewater, a well developed activity in mining, utilizing direct application of water power, and the beginning of an industrial development. It was, however, without a cheap and adequate fuel supply. The problem, therefore, before the engineers was to convert the water powers, which are in the main in the Sierra Nevada, into electrical energy, and to transmit it to the distant power markets already available.

There were many difficulties to be overcome such as the relatively small stream flows, necessitating the use of high heads, the extreme variation in stream flow, the severe cold of the winters with heavy snowfall in the mountains, the ruggedness of the country, as well as the uncertainties and the unknown quantities and qualities involved in the generation and transmission of electrical energy.

For many years the development, construction and operation of the interconnected transmission system of the state have been followed with interest by the electrical engineers of the country, but recently, due to the widespread interest both within and outside of the electrical industry in "Super-power" and "Giant-Power," the methods employed and the results accomplished in California have attracted more widespread attention as demonstrating, in a practical way, the results which can be attained by a regional transmission system.

Maps of Progressive Development

In 1900 there were 21 separate lines operating at 10,000 volts or over, totaling 700 miles, that may be classed, as of that time, as transmission lines. In 1925 there is in operation an interconnected network consisting of about 9,000 miles of line operating at voltages of from 20,000 volts to 220,000 volts. The transmission voltages of 1900 are the distribution

voltages of today, and voltages as low as 10,000 volts now are not classed as transmission.

In order that the progressive steps which have taken place in the development of this network may be presented as clearly as possible, six maps have been prepared, one for 1900, and one as of the end of each five-year period from 1900 to 1925. On the period maps the transmission lines built during the five years are represented by heavy solid lines, and the lines which were in operation at the beginning of the period are shown by lighter broken lines.

The map of 1910 shows that four separate companies by that year had built lines from the mountains to the San Francisco Bay district, and a study of all the maps will show how the lines have been extended gradually, step by step, and mile by mile, over the state from the mountain canyons of the north to the deserts in the south.

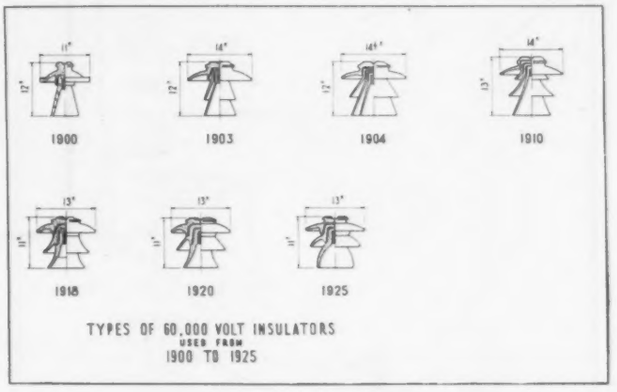
Early Developments

The first hydroelectric transmission line in America was put into operation by the Willamette Falls Electric Company in 1890. Power was transmitted at 4,000 volts over individual circuits from the different generators in the power house to Portland, 13 miles distant. As the load increased, new circuits were added until the pole line carried about thirty wires and had more resemblance to a telephone lead than to that which we now think of as a transmission line.

The first long-distance high-tension transmission line in the world was constructed in 1891 and 1892 by the San Antonio Light & Power Company, largely through the efforts of Dr. C. G. Baldwin, Almerian Decker and William Stanley. The following is a resume of Frederick Hall Fowler's interesting account of this development (see "Hydro Electric Power Systems of California" by Frederick Hall Fowler, Department of the Interior, Water Supply Paper No. 493):

The project was begun largely through chance. In 1890 Dr. C. G. Baldwin was made president of Pomona College. Shortly after his arrival he was urged to join the town Board of Trade. The board offered its support for any undertaking which he considered to be in the interest of the community. Thinking the whole matter a jest, he suggested utilizing the water power in a neighboring canyon for lighting the town. The board accepted the proposal and made him chairman of the Water Power Committee.

Dr. Baldwin acquainted himself with the Ventura system, which consisted of a small direct-current transmission line four miles long. He purchased the site in San Antonio Canyon for $25,000; organized a company; secured the backing of Thomas Bard, which lent business prestige to the scheme, and engaged Almerian Decker to draw up plans and specifications. Dr. Baldwin went to Pittsburgh and presented his plans to the Westinghouse Electric & Manufacturing Company, which declared the plan impracticable and refused to take the contract. Greatly discouraged, Dr. Baldwin proceeded to a missionary conference at Pittsfield, Mass. There he was greatly impressed by the brilliant illumination of the town. He hastened to the laboratory of Mr. Stanley, who was responsible for the success of the system, and placed his plans before him. Mr. Stanley gave his enthusiastic approval and promised to manufacture the machinery himself if neither the Westinghouse nor the Thomas-Houston companies would undertake it. Dr. Baldwin revisited the Westinghouse company, which not only accepted the contract but guaranteed the performance of the generating equipment. The generators were successful from the first, but the motors were not.



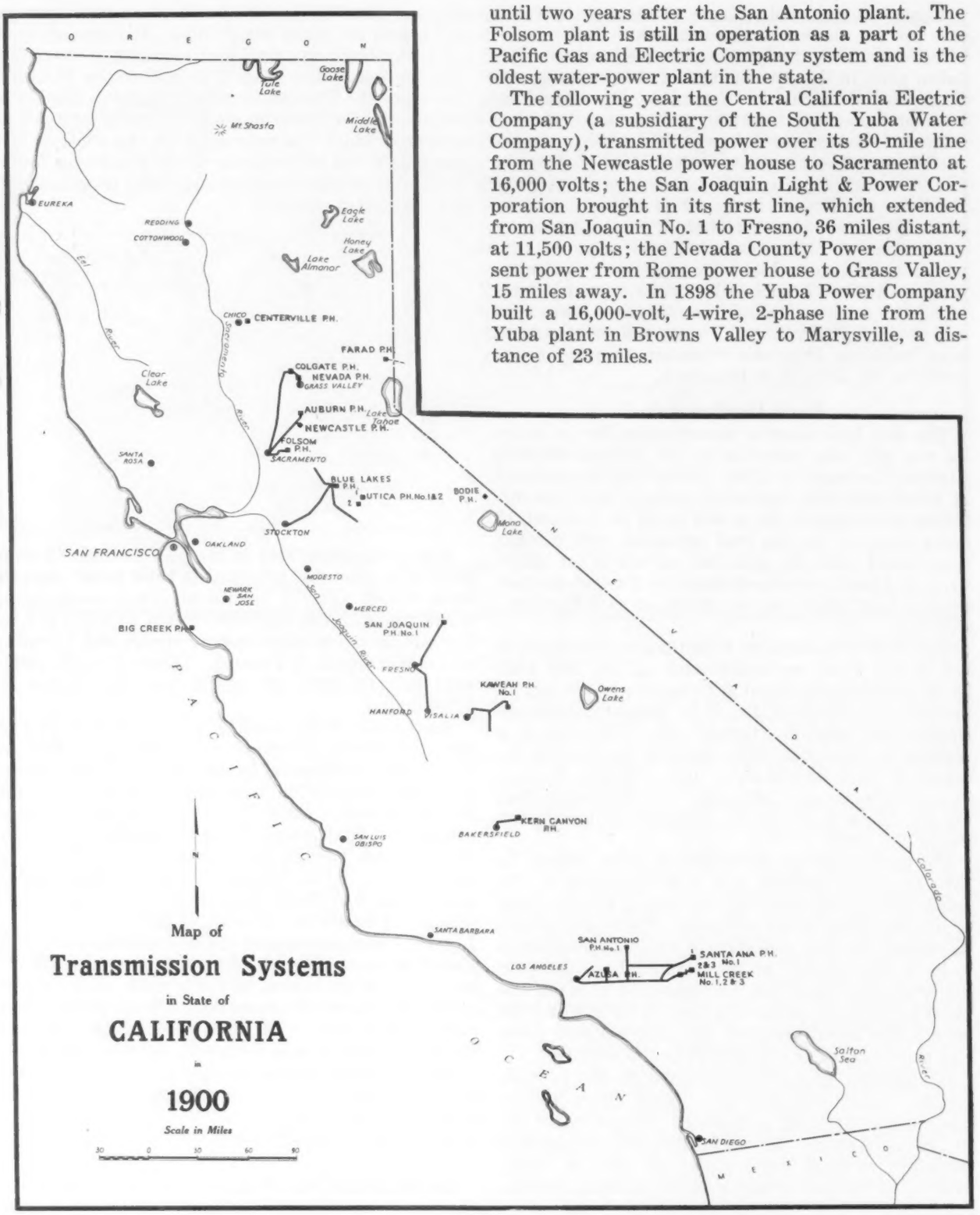
TYPES OF 60,000 VOLT INSULATORS USED FROM 1900 TO 1925

Power was generated in the San Antonio Canyon plant at a generator potential of 1,000 volts; stepped up to 10,000 volts by twenty 6½-kw. transformers, connected in series, and transmitted 28 miles to San Bernardino on one single-phase circuit and 14 miles on another circuit to Pomona. (From Nov. 28, 1892, until Feb. 16, 1893, the energy was transmitted at 5,000 volts.)

September, 1893, marked the completion of the first commercial polyphase transmission system in the world. Undaunted by the refusal of the Westinghouse company to build three-phase generators for the Ponoma plant, Mr. Decker made arrangements with the General Electric Company, through the Redlands Electric Light & Power Company, for the delivery of two 250-kw., 2,400-volt, three-phase generators for direct connection to Pelton water wheels. These were installed in the Mill Creek No. 1 power house, now a part of the Southern California Edison system. The first delivery was made to Redlands, 7½ miles distant, at 2,300 volts. After three years of successful operation, the potential was raised to 10,000 volts and another three-phase, 10,000-volt line built to Riverside, 20 miles distant.

Also in 1893 power transmission was developed by the Standard Consolidated Mining Company at Bodie, in central California. This was a 3,500-volt line, 13 miles in length, which supplied power to the mines.

On Admission Day, Sept. 9, 1895, the Sacramento Electric Power & Light Company put into operation the Folsom plant—the first generating plant of any size in central California. Four 11,000-volt, 3-phase circuits on two pole lines from the power house to Sacramento, 23 miles away, supplied energy for the street railway system, lighting and incidental power. The history of this plant is extremely interesting as it was originally planned by Horatio P. Livermore in the 60's as a hydro-mechanical development, and the



until two years after the San Antonio plant. The Folsom plant is still in operation as a part of the Pacific Gas and Electric Company system and is the oldest water-power plant in the state.

The following year the Central California Electric Company (a subsidiary of the South Yuba Water Company), transmitted power over its 30-mile line from the Newcastle power house to Sacramento at 16,000 volts; the San Joaquin Light & Power Corporation brought in its first line, which extended from San Joaquin No. 1 to Fresno, 36 miles distant, at 11,500 volts; the Nevada County Power Company sent power from Rome power house to Grass Valley, 15 miles away. In 1898 the Yuba Power Company built a 16,000-volt, 4-wire, 2-phase line from the Yuba plant in Browns Valley to Marysville, a distance of 23 miles.

foundation of the dam was started in 1866. The project met with many difficulties for several years, and then Mr. Livermore conceived the idea of an electrical development, with transmission lines to Sacramento, and was working to that end prior to the development in the San Antonio Light & Power Company, although the project was not completed

In 1899 power was delivered in Sacramento at 22 kv. over the 76-mile line of the Bay Counties Power Company from the Colgate plant on the North Yuba River. The voltage was raised in 1900 to 40 kv.

There was during this period a number of other developments under construction or being placed in operation utilizing voltages of from 10 to 22 kv.

Situation in 1900

By referring to the map for 1900 it will be seen that by that year there was a number of lines in operation in the state. Sacramento was supplied by the 40-kv. line of the Yuba Electric Power Company, bringing power from the Colgate plant; the 15-kv. line of the Central California Electric Company from the Newcastle and Auburn plants; and the 11-kv. line from the Folsom plant of the Sacramento Electric Power & Light Company. Two hydro plants, Folsom and Colgate (then only partially completed) and the first steam plant in Sacramento (located in substation at Sixth and "H" Streets), were operating then as one system. A short distance to the south the Blue Lakes Water Company had extended a 17-kv. line to Stockton and also constructed 17-kv. lines north and south along the "Mother Lode" to supply power to the mines in that section. All of these lines are now a part of the system of the Pacific Gas and Electric Company.

Fresno was supplied by a 11-kv. line of the San Joaquin Electric Company from the San Joaquin No. 1 plant, a distance of 36 miles, in 1896. Bakersfield also was supplied in 1897 from a plant on the Kern River by a line of the Power Development Company.

Los Angeles was supplied with power from the Azusa plant of the San Gabriel Electric Company, a distance of 23 miles, at 16 kv. (1898) and from the Santa Ana No. 1 plant of the Edison Electric Company, a distance of 83 miles, at 33 kv., a record voltage in 1899.

The Mt. Whitney Power Company commenced operation in 1899, transmitting power at 15,000 volts.

It will be seen clearly from the map that all these as yet were isolated lines and that the system development, as we now know it, had not yet been started except in the vicinity of Sacramento.

Outstanding Accomplishments

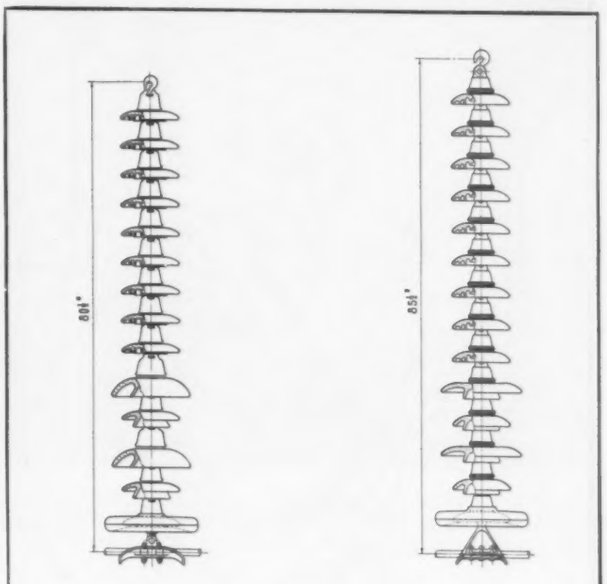
During the next five years the development was very rapid and 1905 found the system of the Pacific Gas and Electric Company taking definite form, as well as a number of lines of the Edison Electric Company and the Pacific Light & Power Company in operation in the southern part of the state.

It is not necessary to trace the growth of the systems from this time on as it is clearly shown on the maps, but the following are some of the outstanding accomplishments which attract our attention in reviewing the entire period from 1900 to 1925:

1901—The Bay Counties Power Company constructed two pole lines from Colgate to Oakland, a distance of 142 miles, in the year 1900, and these lines, then the longest transmission lines in the world, were placed in operation early in 1901 and operated first at 40,000 volts. Later the voltage was raised to 50,000 and in 1903 to 60,000.

A feature of the construction of this line was the crossing of Carquinez Straits with a 4,427-ft. span. That the pioneers built well is evidenced by the march of events, as the towers supporting this span constructed to support one 60-kv. circuit and one spare conductor now are supporting two 110-kv. circuits. Two additional cables were added in 1914 and the voltage raised to 110 kv. in 1922.

1903—In February of this year the lines of the Bay Counties Power Company and the Standard Electric Company were connected temporarily at Oakland, and while the plant of the latter company was being repaired power was transmitted over 300 miles. This was probably the greatest distance over which power ever had been transmitted commercially.



STANDARD STRINGS OF INSULATORS
(DIFFERENT MANUFACTURERS)
USED ON 220,000 VOLT TRANSMISSION LINE
OF PACIFIC GAS AND ELECTRIC CO.

1904—The Pacific Light & Power Company installed a 16-mile, 80-kv. experimental line using nine different types of insulators with both wood and metal pins. This line was built to determine the proper voltage to use for transmitting 10,000 hp. from the Kern River to Los Angeles, 125 miles.

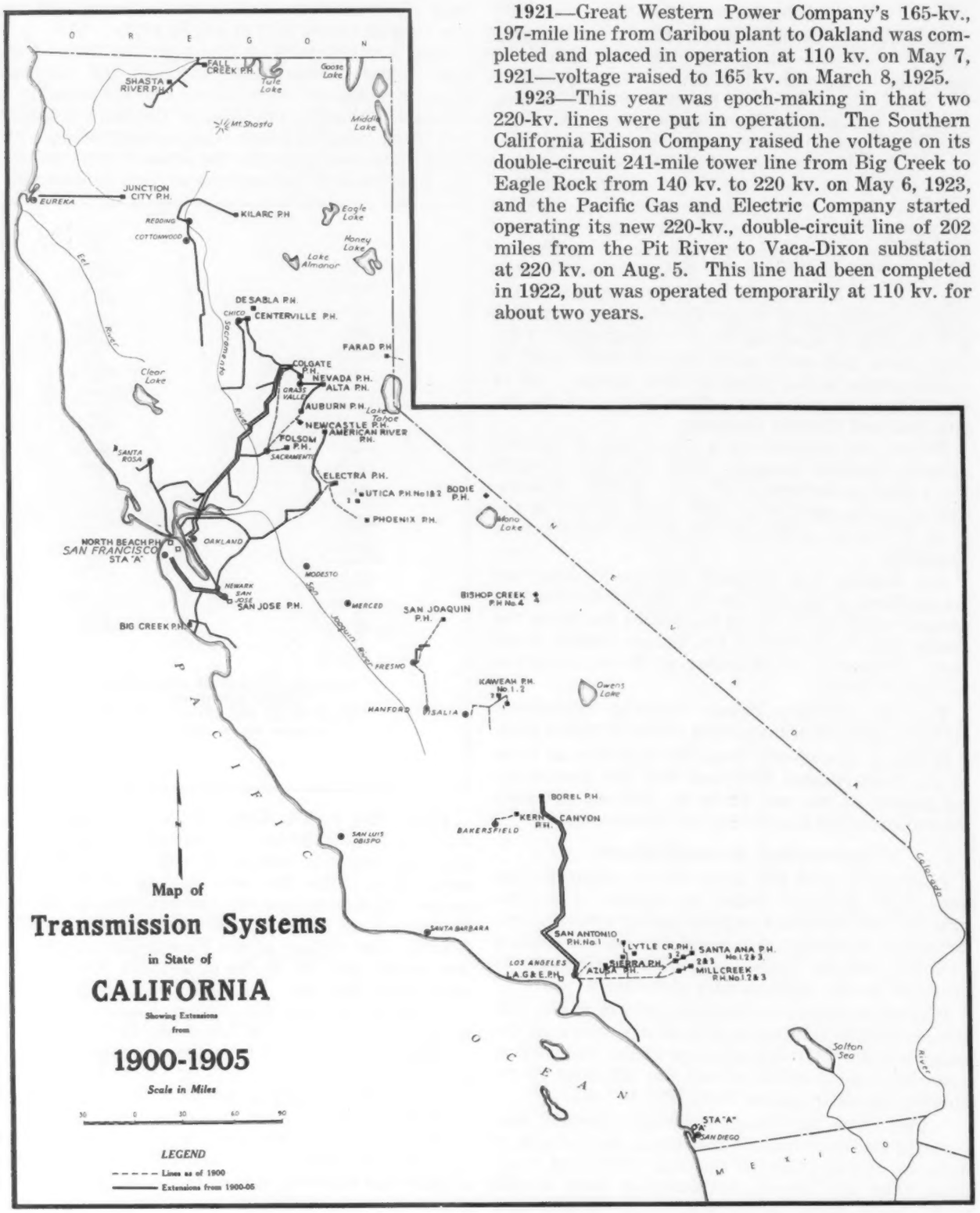
1905—The voltage of the Folsom-Sacramento line was raised from 11 kv. to 60 kv. and the four circuits made into one.

In this same year the Edison Electric Company built a 14-mile steel pole line using latticed poles.

1906—The Edison Electric Company built the first steel-tower line and the highest voltage line in the state, in constructing a 118-mile, 75-kv. line from Kern River No. 1 plant to Los Angeles.

1908—The Great Western Power Company put in operation the first 100-kv. transmission line, which shortly was followed by the line of the Sierra & San Francisco Power Company at 104 kv.

1913—The Southern Sierras Power Company completed the construction of a tower line from Bishop Creek to San Bernardino, a distance of 239 miles. This line was constructed to operate at 150 kv., but was operated at 55 kv. until early in 1917 when it was raised to 95 kv. This line has been extended to Yuma, Ariz., making a total transmission distance of 539 miles, which is certainly a record for regular



1921—Great Western Power Company's 165-kv., 197-mile line from Caribou plant to Oakland was completed and placed in operation at 110 kv. on May 7, 1921—voltage raised to 165 kv. on March 8, 1925.

1923—This year was epoch-making in that two 220-kv. lines were put in operation. The Southern California Edison Company raised the voltage on its double-circuit 241-mile tower line from Big Creek to Eagle Rock from 140 kv. to 220 kv. on May 6, 1923, and the Pacific Gas and Electric Company started operating its new 220-kv., double-circuit line of 202 miles from the Pit River to Vaca-Dixon substation at 220 kv. on Aug. 5. This line had been completed in 1922, but was operated temporarily at 110 kv. for about two years.

operation. In 1924 an 83-mile extension establishing a connection with the San Diego Consolidated Gas & Electric Company was built to Rincon from El Centro.

1913—Southern California Edison Company put into operation a 140-kv., 241-mile line from Big Creek to Eagle Rock on Nov. 8, 1913.

As far as the writer knows these two lines are still the only ones operating at so high a voltage.

Design and Construction

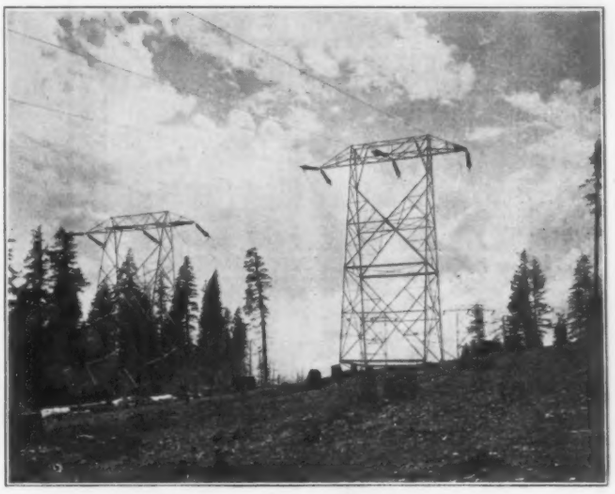
In the early days the location of the high-tension lines was one of rather simple economics. A definite amount of hydroelectric power at the power house

in a mountain canyon had to be transmitted to a substation supplying a city distribution system. These lines followed highways, railroad rights-of-way, and any easy and inexpensive route. The poles were usually squared redwood or round Douglas fir with one crossarm, the third insulator being mounted on the pole top. The poles were spaced uniformly except where long spans were necessary across canyons. In these spans wood frames were built, and the strain of the conductor was taken on a series of several insulators in a row. The conductor spacing was originally from 30 to 42 in., but lines of later date were increased due to large birds causing short circuits. The spacing between wires was 60, 72, and 84 in. for 60,000 volts.

Insulation was in these early days, as it is today, a vital and difficult problem of design and operation. The shapes and materials were made to provide protection in accordance with some preconceived conceptions as to what might take place. The "gutter type" or "water spout type" used on the two lines built into San Francisco in 1901 was the first used for 60,000 volts, and consisted of two parts cemented together. The top part was 11 in. in diameter and had cable and tie grooves as copied from the telegraph-line insulators, but the brim of the "hat" was constructed with a gutter around the edge, and a spout to discharge the rain clear of the lower part of the insulator. It was feared that if the drippings during a rain storm were allowed to surround the insulators completely serious leakage and flashing would result; to prevent this the gutter was formed. The lower part was a clear glass petticoat about 9 in. long over all with a flare of 6 in. at the bottom, and was cemented in place with sulphur and sand. The purpose of the petticoat was to prevent charring of the insulator pin and to keep it dry. In 1898 pins of turned eucalyptus wood boiled in linseed oil with threads to screw into the insulator were developed. One line was built with a porcelain sleeve around the pin under the petticoat. The next step was to increase the size of the head at the cable tie groove, and to leave off the gutter around the rim; then followed a 14-in. insulator with a third part, consisting of a shorter petticoat introduced between the pin petticoat and the head. In some types the third part was short and was set into the head part before firing. This left only one cemented joint to be made. In 1904 and 1905 the "California type" was developed, consisting of four parts cemented together. The fourth petticoat was completely enclosed, and the head was 14½ and 16 in. in diameter. The California type became a sort of standard for 60,000 volts or thereabouts for many years. The later improvements gave more flare to the petticoats to permit of washing of the inner surfaces by rain. The insulators of today are much thicker in cross-section of material and are usually three-part with less narrow space between the petticoats. The diameters are also somewhat less, being about 13 in.

With the growing necessity for larger blocks of power to be transmitted, economic transmission made higher voltages necessary, and transformers to provide these higher voltages were demanded of the manufacturers. With the development of the suspension-type insulator in 1906 and the use of wind-mill-type steel towers to provide for increased clearance impossible with wood pole construction, line potentials of over 100,000 volts rapidly came into use.

The adaptability of suspension-type insulators to higher voltages gave an impetus to this class of construction and also, more important, the economical transmission of power from more distant and larger developments. The higher voltage lines then became the main trunk lines and the carriers of power from groups of power houses in the mountains, the energy being delivered to one or more distant transmission substations whose function was to feed the network at lower transmission voltages.



Dead-end towers in the mountain section on the Pacific Gas and Electric Company's 220-kv. Pit River line. In the valley section both circuits are carried on one tower

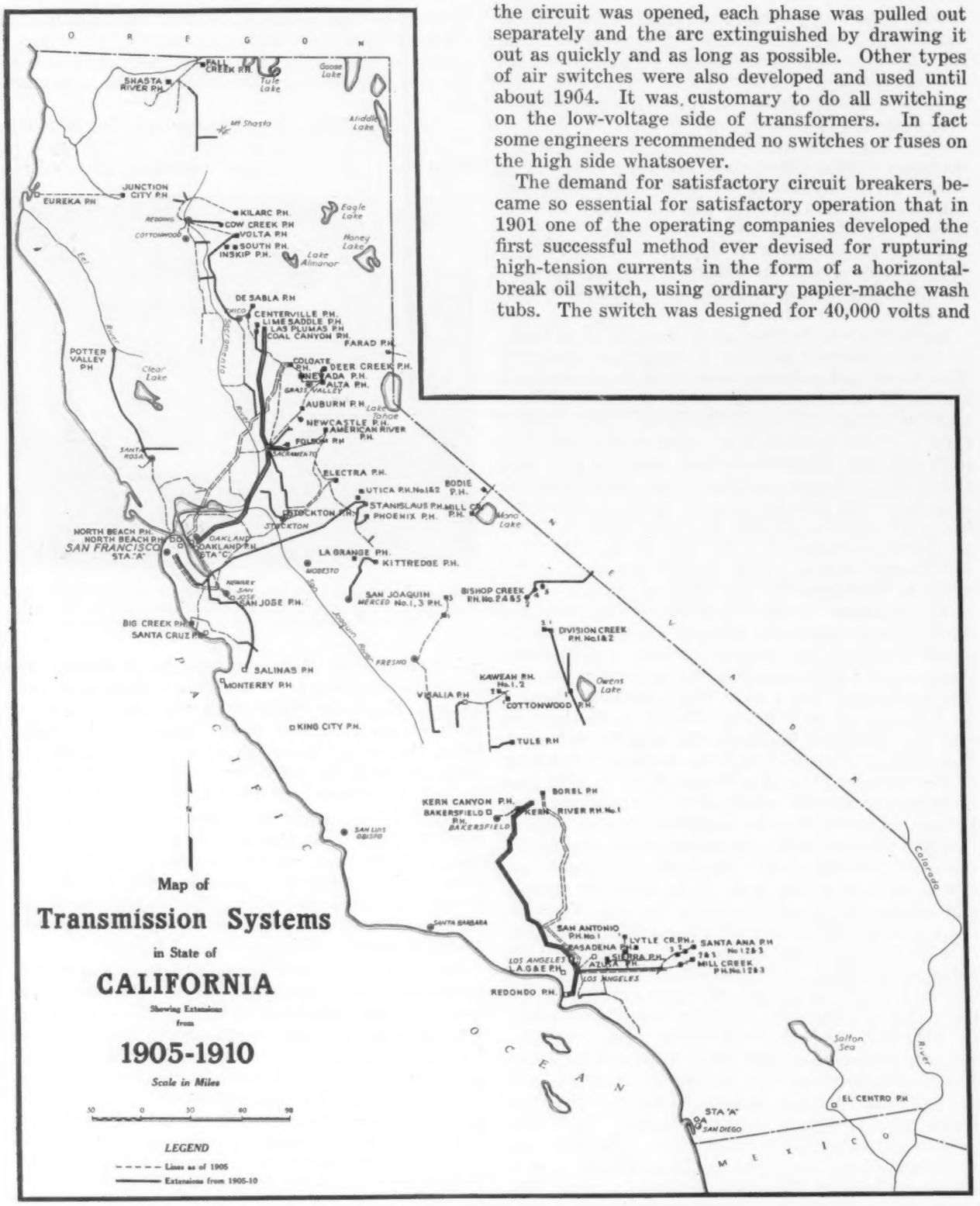
Today the standard steel towers for 220,000 volts used by the Pacific Gas and Electric Company are about 100 ft. high, and are designed to support six copper cables one inch in diameter on an 800 ft. span loaded with sleet and wind. The suspension insulators for this voltage consist of 13 discs of 10 in. and 14-in. diameter, making a string 7 ft. long.

There also have been some changes in the type of conductors used. A great many of the early lines were built with aluminum cables as well as copper. As transmission line loads increased and more amperes had to be carried, more conductivity was required, giving an impetus to the use of copper cables. When the aluminum cable manufacturers produced the steel-core aluminum cables, decreased sags with this type of conductor became possible, and today both copper and aluminum steel-core cables are in use. The conductors on the 220-kv. Pit River line in the mountains consist of special cables one inch in diameter, 518,000 circ. mil of aluminum in 42 wires wound on a steel center consisting of 19 strands. In the valley section special rope-laid copper cables of 500,000 circ. mil consisting of 7 strands of 7 wires each are used.

In the early days the attitude toward switching and the methods used are of interest. The voltage of the circuit was of more importance than the

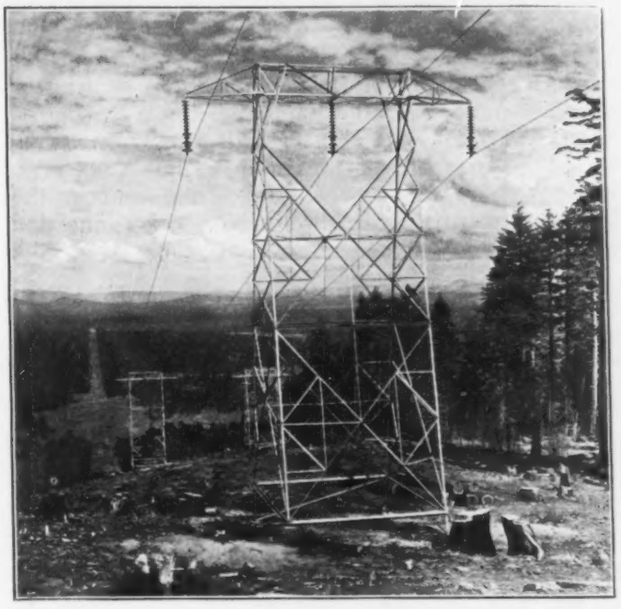
the circuit was opened, each phase was pulled out separately and the arc extinguished by drawing it out as quickly and as long as possible. Other types of air switches were also developed and used until about 1904. It was customary to do all switching on the low-voltage side of transformers. In fact some engineers recommended no switches or fuses on the high side whatsoever.

The demand for satisfactory circuit breakers became so essential for satisfactory operation that in 1901 one of the operating companies developed the first successful method ever devised for rupturing high-tension currents in the form of a horizontal-break oil switch, using ordinary papier-mache wash tubs. The switch was designed for 40,000 volts and



amount of generating capacity, and, as the oil switch development lagged behind in the matter of voltage, fused air-break switches were devised for emergency operation. Back in 1897 these air-break switches were of fearful and wonderful design, called "plug type." These provided for plugging flexible connections by means of a long stick into receptacles. When was revolutionary in high-tension switching equipment. There was one switch and tub on each conductor, hand-operated with remote control, which gave extraordinarily good service considering the low cost of manufacture. Its advent is important in history as the idea is fundamental with all subsequent switching developments.

One of the big problems presented in the joining together of the entire generating capacities of practically all of the power developments in the states of Oregon and California comes in the rupturing capacity of oil circuit breakers. Not only does the capacity of all the plants on the adjacent system concentrate on every switch, but also all that of the connected systems. It is the present practice of the Pacific Gas and Electric Company to specify oil circuit breakers at main switching points of about one million kilowatt rupturing capacity.



Standard mountain-type 220-kv. tower on Pacific Gas and Electric Company's Pit River line

Load Dispatching

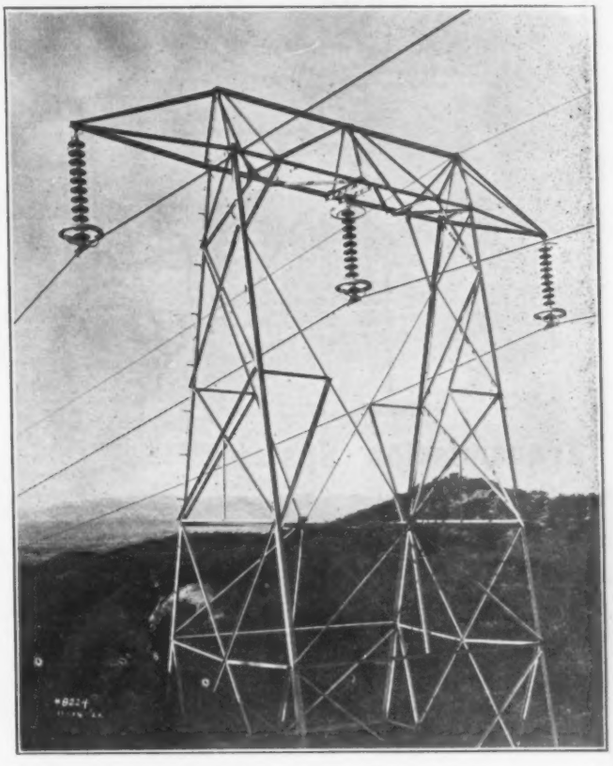
One of the collateral developments of interconnected plant operation was a method of control that is called "load dispatching," and today each of the large companies operating a number of plants has a load dispatcher who controls and directs the operation of all power plants, transmission lines and main substations. This control is exercised through a centrally located office with telephone connections, generally over private lines, with all power houses and substations. The load dispatcher has in front of him a diagram showing all lines and switches, and no switch may be opened or closed without his permission. He directs the amount of load that each plant is to carry from hour to hour and which plant is to govern the system and take the load fluctuations. He also directs the reservoir control, the canal flows, the regulations of voltage, the taking of lines and equipment out of service for repairs, and all other matters affecting the service under both normal and emergency conditions.

The first formal recognition of load dispatching as an essential feature of operation was in 1906 when the California Gas & Electric Corporation (predecessor in interest of the Pacific Gas and Electric Company) placed the operating control of its properties in the hands of a "load dispatcher" with headquarters in Oakland. By 1910 all of the large companies in the state had adopted this method of operation.

Interconnection

Prior to the war period connections had been established between the systems of the various companies, in some cases for the purpose of interchanging energy and standby service but principally to dispose of surplus power under contracts. The curtailing of construction, the high price of fuel, the general conservation policy of the country combined with a period of low rainfall and the appointment of a power administrator by the Railroad Commission of California all resulted in further interconnections and unified operations of practically all of the plants in the state, which resulted in the greatest possible utilization of the water-power and steam-power resources of all of the companies.

Practically every interconnection in the state has been made for the purpose of the delivery of a definite amount of power from one company to the other under contract, each step in the interconnections of the systems thus being justified economically at the time it was made. This method has resulted without any heavy financial burden, in the installations of lines and facilities, which are now of the greatest value in times of emergency in transferring power from one section of the state to another.



Southern California Edison Company's 220-kv. Big Creek line showing standard insulator strings. (Upper shield ring shown on middle string has been removed)

With the exception of those of the Southern California Edison Company and the City of Los Angeles, all of the plants in Californa operate at a frequency

Southern California Edison Company's system and San Joaquin Light & Power Corporation. The Southern Sierras Power Company and the San Diego Consolidated Gas and Electric Company.

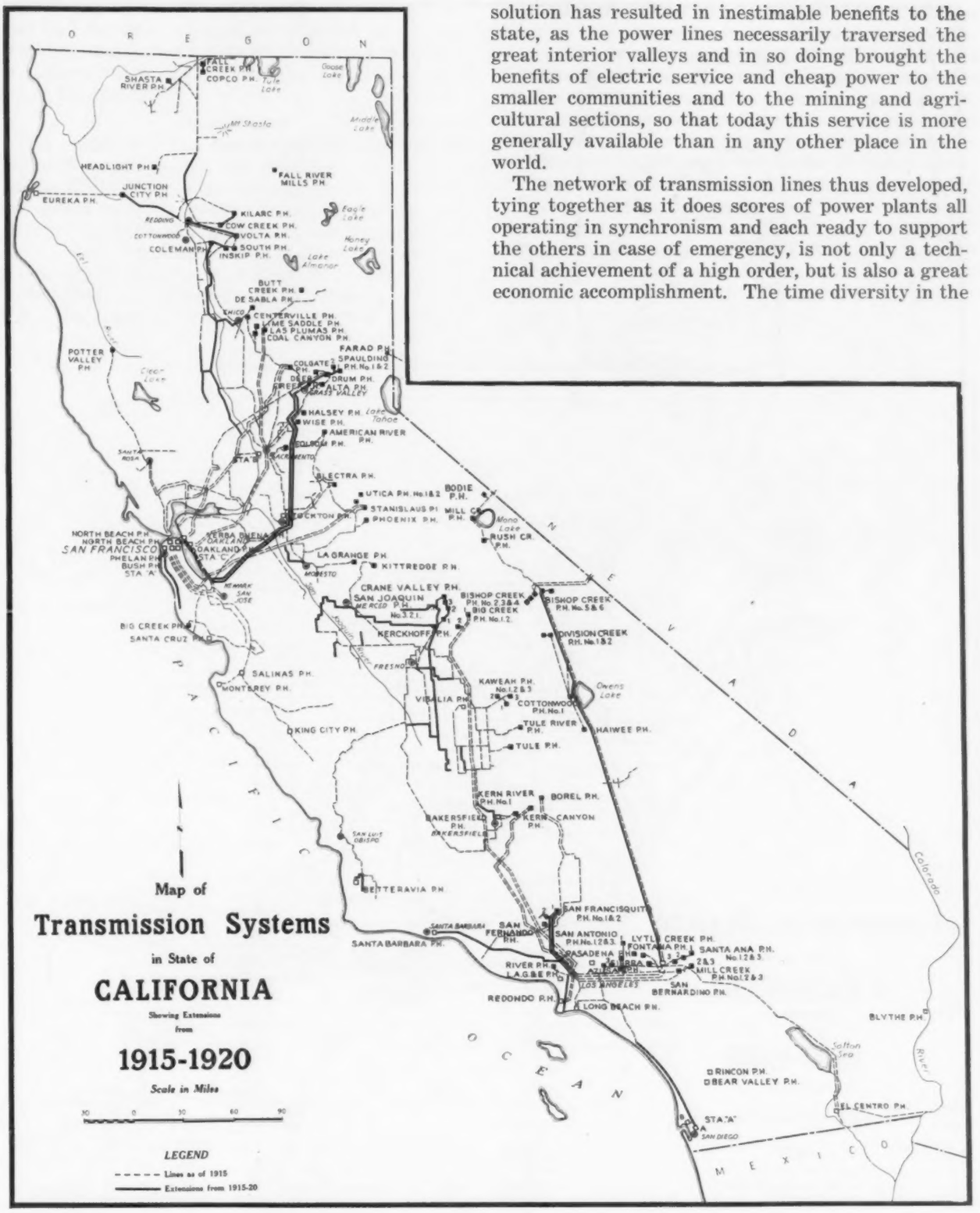
Today the interconnections provide a physical continuity of transmission circuits between Vancouver, Wash., and Yuma, Ariz., a total distance of about 1,400 miles. With the closing of a 30-mile gap between Vancouver and Kalama, Wash., a continuous physical connection will tie together the Washington-Montana system with that of California and Oregon. This immense territory, then to be interconnected, will cover six far western states and connect the Mexican line with British Columbia. This connection will provide a continuous line from Yuma, Ariz., to a point beyond Billings, Mont., a distance of about 2,300 miles, which is equal to a straight-line distance from New York to El Paso, Texas.

of 60 cycles. That portion of the Edison company's system which formerly was owned by the Mt. Whitney Power & Electric Company is also operated at 60 cycles, but the main part of its system and the plants of the City of Los Angeles operate at 50 cycles. Interconnections, however, have been established through frequency-changer stations between the

It is not claimed that power from steam plants in Portland, Ore., is delivered to Yuma, but, by reason of the interconnection, load adjustments can be so distributed that Yuma is able to be supplied ade-

solution has resulted in inestimable benefits to the state, as the power lines necessarily traversed the great interior valleys and in so doing brought the benefits of electric service and cheap power to the smaller communities and to the mining and agricultural sections, so that today this service is more generally available than in any other place in the world.

The network of transmission lines thus developed, tying together as it does scores of power plants all operating in synchronism and each ready to support the others in case of emergency, is not only a technical achievement of a high order, but is also a great economic accomplishment. The time diversity in the



quately even when the local supply is entirely inadequate.

Diversity and Load Factor

As stated before, the problem presented to the pioneers was to transmit the water powers of the Sierra to the Coast cities where the power markets were situated. The existence of this problem and its power requirements of the great variety in the classes of load supplied has been taken advantage of to a maximum degree. The plant capacity which is used to supply the lighting peaks of the cities in the winter is used for reclamation pumping in another section in the early spring, for irrigation pumping in the late spring and early summer, and again for

operating the fruit-icing plants and canneries in the late summer.

An analysis of the various kinds of load carried by the companies of California shows a somewhat different ratio of classes of business than that connected to large Eastern public utilities. Taking the Pacific Gas and Electric Company as typical, there is found for the year 1924 a sharp evening peak of 343,701 kw. occurring Dec. 19, with a daily load factor of 67 per cent. This peak was due to the overlapping of lighting and transportation demands with industrial uses. However, on July 29 of the same year there occurred a morning peak of 337,069 kw., which was not sharp like the one in December but continued for 1½ hours and gave a daily load factor of 79 per cent. The diversity thus becomes progres-

sive so that on many of the large systems the annual load factor is as high as 65 per cent. It was this high load factor which surprised and interested Dr. Steinmetz when he visited California shortly before his death.

Plant Factor

The report on "The Superpower System for the Region Between Boston and Washington," prepared for the United States Government by W. S. Murray and others in 1921, stated that all of the plants as operated in 1919 had an annual capacity factor—that is, the average load on all plants expressed as a percentage of the total capacity of the plants for the Boston-Washington region—of 26 per cent, and that, under the superpower system which was proposed, the annual capacity factor for the same region in 1930 was estimated at 45 per cent.

In 1923 the annual capacity factor of all plants in the state of California was about 45 per cent as compared with the 26 per cent for the Boston-Washington region or 1.73 times as great. In other words, it may be said that the dollars invested in generating plants in California are working 73 per cent more hours during the year than the dollars similarly invested in the Boston-Washington region, and this ratio would be even higher were it not for the fact that, due to the long dry season, it is necessary to have a considerable installation in steam standby plants, which are, in a sense, a duplication of the installation in hydroelectric plants. The practical effect of this difference in plant factor is that all costs which are not a function of the number of kilowatt-hours produced—and this will include interest, depreciation, taxes, insurance and to a degree maintenance and operating expenses—may be spread over 73 per cent more kilowatt-hours, thus reducing by 42 per cent the share of these costs chargeable to each kilowatt-hour.

Conclusion

While the foregoing is a very condensed account of the development of the interconnected transmission system of California, it is hoped that it will serve to convey, at least in a general way, an understanding of the problems encountered, the resourcefulness and courage of the pioneers, as well as some comprehension of the beneficial results which have accrued to the entire state by their efforts and those of their successors. For, as has been stated, the technical achievements have resulted in immeasurable economic benefits to the state and its people in that the power of its mountain streams has been made available not only to the cities and towns but to the mining and agricultural sections as well, and furthermore, as a result of the high load factor and plant factors obtained by the regional systems, taking advantage of the load diversities, economies in operation and investment have resulted in low rates for service.

Miles of Transmission Line, Principal Hydroelectric Plants, and Installed Plant Capacities in California, Dec. 31, 1924

	Miles of Line							Principal Hydroelectric Plants (2,000 kw. and over)	Number of Plants		Total Installed Capacity	
	20 kv. and under 33 kv.	33 kv. and under 60 kv.	60 kv. and under 100 kv.	100 kv. and under 165 kv.	165 kv.	220 kv.	Total		Hydro	Steam	Hydro	Steam
Pacific Gas and Electric Company	157	...	2,039	607	...	262	3,065	Alta, Bullards Bar, Centerville, Coleman, Colgate, Deer Creek, De Sabla, Drum, Electra, Folsom, Halsey, Inskip, Kilarc, Lime Saddle, South Spaulding 1, Volta, Wise, Hat Creek 1 & 2, Pit 1, Spring Gap, Stanislaus	27	4	317,975	142,000
Southern California Edison Company	90	...	1,203	.....	...	535	1,828	Big Creek 1, 2, 3, 8, Borel, Fontana, Kaweah 3, Kern River 3, Tule, Mill Creek 3, Santa Ana 1	21	4	278,150	150,450
San Joaquin Light & Power Corporation	170	....	881	208	...	...	1,259	Canyon, Kerckhoff, San Joaquin 1, 2 & 3, Tule River	11	3	86,600	54,050
Great Western Power Company	350	170	.....	180	196	...	896	Big Bend, Caribou	2	6	131,000	30,800
The Southern Sierras Power Company	...	14	664	.....	...	...	658	Adams Auxiliary, Adams Main, Bishop Creek 2, 3, 5 & 6, Leevining Creek, Mill Creek, Rush Creek	12	...	62,558	.....
Western States Gas & Electric Company	12	...	305	.....	...	...	317	American River, El Dorado, Junction City	3	2	26,650	9,250
City of Los Angeles	*	160	.....	91	...	...	251	Franklin Canyon, River Power, San Fernando, San Francisquito 1 & 2	9	...	70,050	.....
The California Oregon Power Company	...	119	127	.....	...	...	246	Copco, Fall Creek	4	...	28,510	.....
Midland Counties Public Service Corporation	...	...	172	.....	...	...	172		...	...	.....	.....
Coast Valleys Gas & Electric Company	90	75	.....	.....	...	...	165		...	3	.....	1,375
San Diego Consolidated Gas & Electric Company	...	...	107	.....	...	...	107		...	2	.....	37,250
Snow Mountain Water & Power Company	...	107	.....	.....	...	...	107	Potter Valley	1	...	6,400	.....
Miscellaneous	47	11	32	3	...	...	93		15	7	28,500	101,705
Total	916	656	5,510	1,089	196	797	9,164		106	31	1,036,393	525,380

Total, 1,561,773 kva.

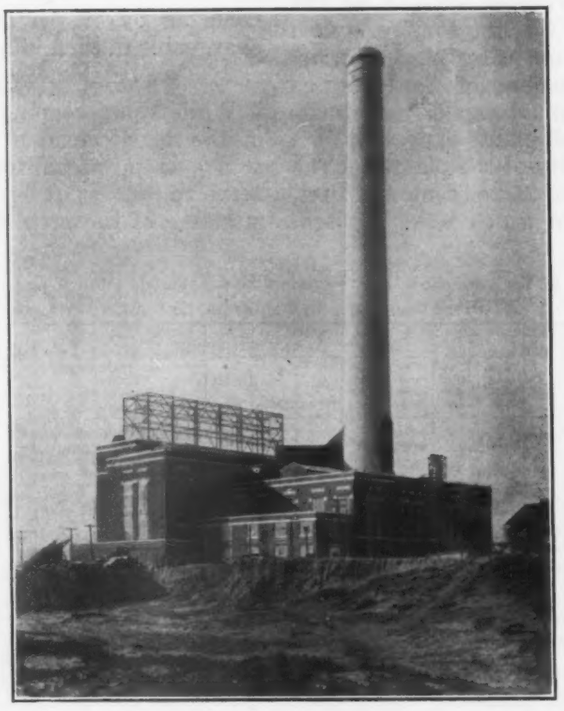
* 1922

The Seal Beach Power Station

By J. G. Rollow[1] and D. L. Galusha[2]

THE Seal Beach power station of the Los Angeles Gas and Electric Corporation is the second large modern station to go into operation recently on the Pacific Coast for generation of electricity by steam prime movers. The other is the Long Beach No. 2 plant of the Southern California Edison Company, which was described in this Journal March 15, 1925. It is expected that many delegates will visit these plants either before or after the convention, since they are both located near the city of Long Beach and only six miles apart.

The Seal Beach location, situated about thirty miles from the business center of Los Angeles, is east of Long Beach on Alamitos Bay, at a point where ample circulating water can be drawn economically from the bay and discharged into the ocean. Owing to the topography of the shore, existing ocean-front property developments and adverse water conditions, suitable sites are very limited. The site chosen is the nearest to the load of those considered acceptable under existing conditions.



The Seal Beach steam plant designed and erected by Dwight P. Robinson & Company, Inc., for the Los Angeles Gas and Electric Corporation embodies many novel features. The present rated capacity of the station is 30,000 kw. with provisions for an additional unit of the same capacity. The ultimate capacity of the plant is 200,000 kw.

The site is suitable for the expected ultimate development of 200,000 kw. The initial step consists of one turbine, having a nominal rating of 30,000 kw. at 80 per cent power factor, and three boilers each of 25,450 sq. ft. of heating surface. The actual capacity of the machine, on a conservative basis, as shown by tests, is 35,000 kw. at 80 per cent power factor, and it will be operated at that rating. There is room in the present buildiing for two such units.

The boilers are designed for an operating pressure of 375 lb. per sq. in. While higher pressures were considered, it was decided to adhere to this design, since operating characteristics, first costs and maintenance costs have not been established fully for the higher pressures, and reliability of service was of prime importance.

Some of the outstanding features of the plant are: (1) Low total cost of current inclusive of fixed charges. (2) High thermal efficiency. (3) Low investment cost per kilowatt. (4) Four-stage bleeding of turbines. (5) Air preheaters reclaiming heat from flue gases. (6) Condensate coolers for generators, transformers, turbine bearing oil and air ejectors. (7) Combination oil and gas firing. (8) Natural conditions of site utilized to avoid recirculation of condensing water and improved conditions at the intake. (9) House generator direct-connected to turbine shaft. (10) Automatic throw-over of auxiliary motors from one bus to the other when power fails on either. (11) Auxiliaries all electrically driven except one boiler feed pump and duplex drive exciters. (12) Buses at generator voltage eliminated. (13) Direct current eliminated except for excitation and control circuits. (14) High-tension equipment indoors.

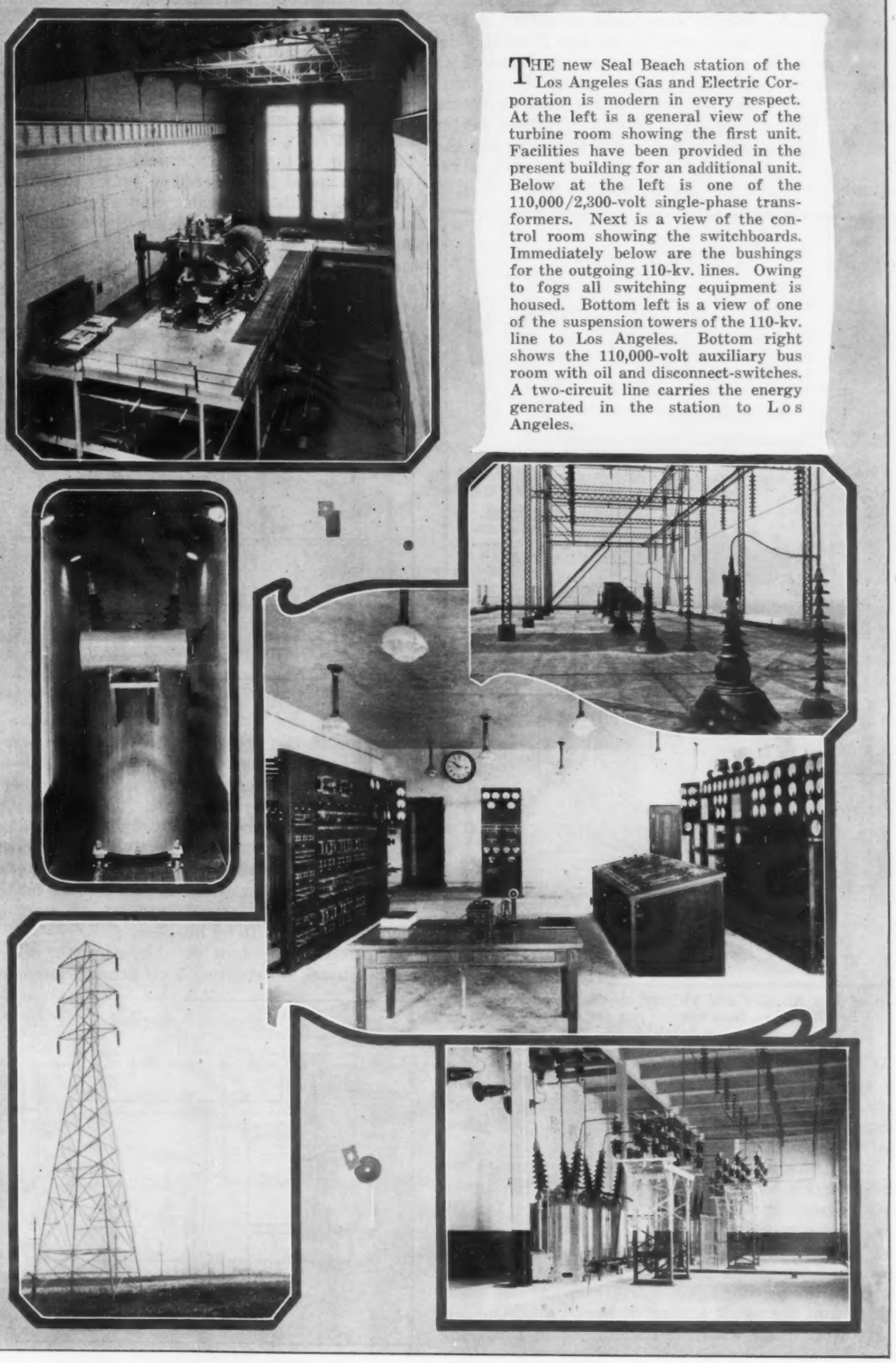
Station Both Efficient and Economical

The policy underlying the design was to obtain the lowest total cost of current, inclusive of fixed charges, consistent with the high standard of reliability required by the Los Angeles Gas and Electric Corporation, which has built up its business on a reputation for reliable service. This policy required that all elements of design intended to increase thermal efficiency be analyzed carefully before adoption to insure that the maintenance and investment charges against them would not eat up the savings of higher efficiency. The extent to which this policy has been effective must be judged by the results. While the station has not been in service long enough to give operating records, an average thermal efficiency of approximately 15,000 B.t.u. per kw-hr. is indicated. The investment cost for the completed two-unit station, using the same unit prices for second unit equipment as obtained for the first, will be $85 per kilowatt, based on the actual capacity of the units, viz., 35,000 kw. at 80 per cent power factor. This corresponds to $100 per kilowatt for the nominal rating of 30,000 kw. at 80 per cent power factor.

Bleeding and Preheating

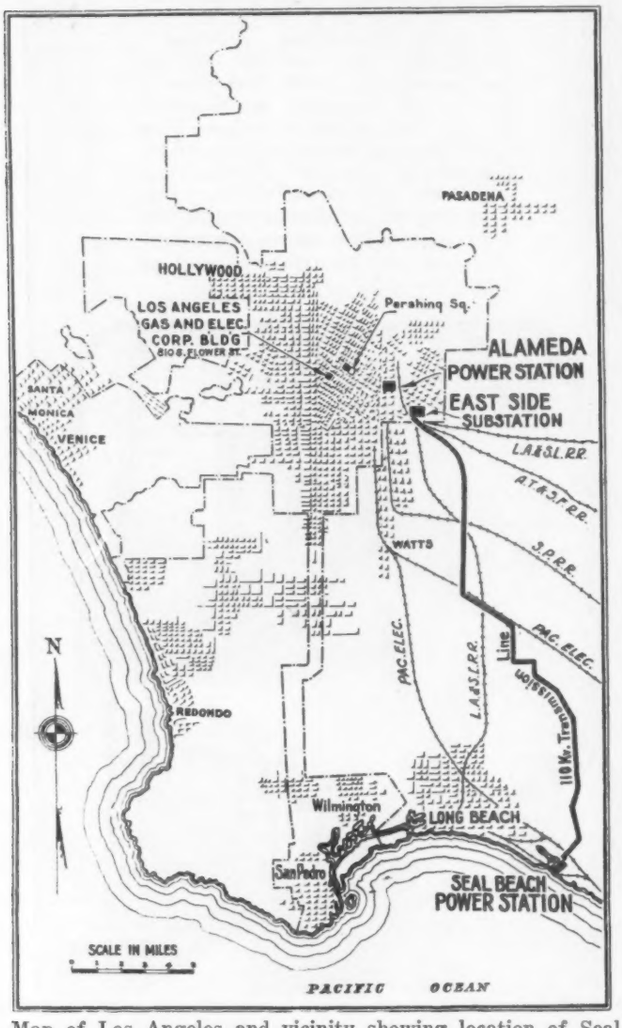
Four-stage bleeding and air preheaters were adopted after a thorough analysis of other available

[1]Electrical Engineer, Los Angeles Gas and Electric Corporation.
[2]Consulting Engineer, Dwight P. Robinson & Company, Inc.



THE new Seal Beach station of the Los Angeles Gas and Electric Corporation is modern in every respect. At the left is a general view of the turbine room showing the first unit. Facilities have been provided in the present building for an additional unit. Below at the left is one of the 110,000/2,300-volt single-phase transformers. Next is a view of the control room showing the switchboards. Immediately below are the bushings for the outgoing 110-kv. lines. Owing to fogs all switching equipment is housed. Bottom left is a view of one of the suspension towers of the 110-kv. line to Los Angeles. Bottom right shows the 110,000-volt auxiliary bus room with oil and disconnect-switches. A two-circuit line carries the energy generated in the station to Los Angeles.

methods of obtaining heat balance and reclaiming flue gas losses. While there were no plants in service using four-stage bleeding at the time the decision was made, the engineers were convinced of its value. Since that time another plant using four-stage bleeding and designed by the same engineers has gone into service. The results have been better than the predictions, probably due to advancing the dew point further toward the exhaust with a resultant increase in low-pressure stage efficiency.



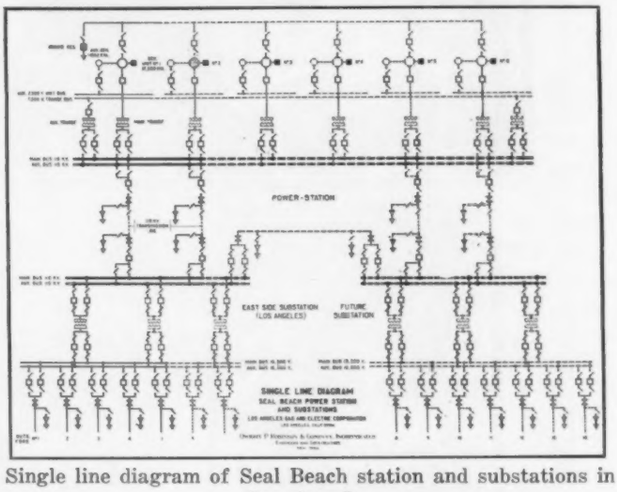
Map of Los Angeles and vicinity showing location of Seal Beach station, transmission line and new East Side substation

While the use of air preheaters shows only a small net return with present fuel costs, it was considered advisable to install them as an insurance for high operating efficiency under the higher fuel prices likely to prevail in the future.

Condensate flows from the hot well through the generator air coolers, transformer heat exchangers, turbine bearing oil cooler and condensers for the steam jet air pumps, in the order named. At full load about 25 deg. F. is added to the condensate temperature from recovered losses, but this is not a net saving as the bleeder heaters do somewhat less work. Aside from the small saving of heat units, the certainty that clean water is circulating in these important pieces of equipment is a distinct advantage for the method. For emergencies raw water can be used in place of the condensate.

Combination Oil and Gas Furnaces

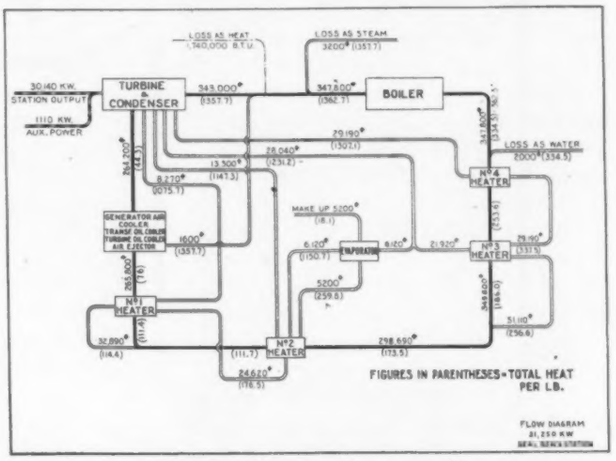
Furnace equipment is designed for firing by either oil or gas. The burners are of the forced draft mechanical atomizing type, each boiler having two rows of seven each, so designed that the change-over in fuels can be made very quickly. One motor-driven variable speed fan per boiler draws the combustion air through the preheater and supplies the forced draft for the burners. Under the usual conditions the boilers will operate at less than 200 per cent of rating although provision has been made to operate at 300 per cent in emergencies. Extremely high ratings for oil-fired furnaces are not considered conservative in the present state of the art, especially where maximum dependability is desired.


POWER-STATION
EAST SIDE SUBSTATION (LOS ANGELES)
FUTURE SUBSTATION
SINGLE LINE DIAGRAM SEAL BEACH POWER STATION AND SUBSTATIONS

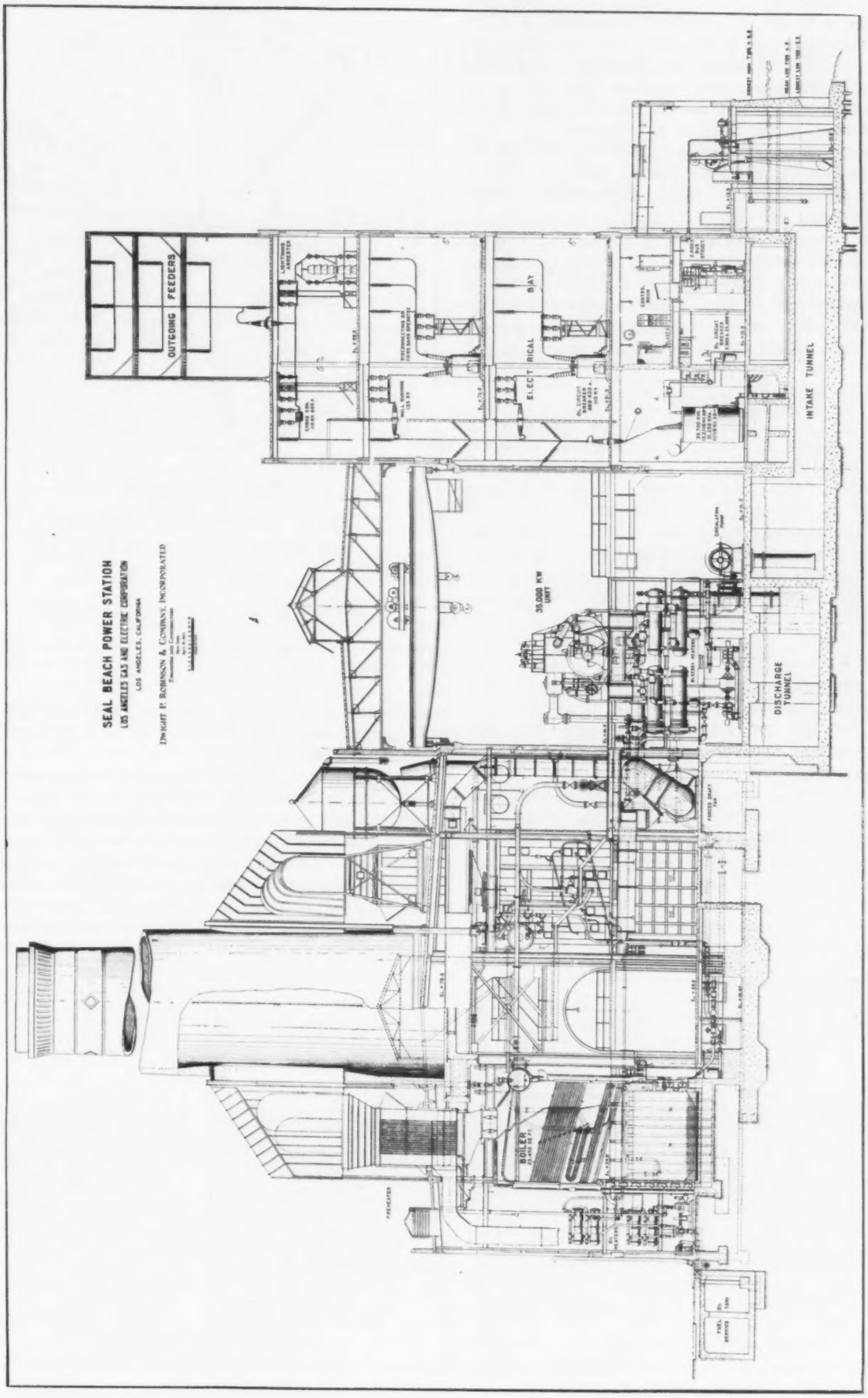
Single line diagram of Seal Beach station and substations in Los Angeles

The natural advantages of the site have been utilized by placing the intakes on Alamitos Bay, which forms one boundary of the property, and discharging the circulating water directly into the ocean. The chance of recirculation thereby is reduced to a minimum. The location of the intake screens on the bay is also favorable from the point of view of the amount of debris to be handled.

The most important consideration for the major auxiliaries is reliability. Two prime sources of cur-



Heat flow diagram for one unit



Cross-section of 200,000-kw. Seal Beach station of the Los Angeles Gas and Electric Corporation. The present building has one 35,000-kw. unit installed and facilities for a second unit. The utimate capacity of the plant is six units

rent for supplying the auxiliaries have been provided: one a house or auxiliary generator at 2,300 volts direct-connected to the main turbine shaft; the other a bank of transformers stepping down from the high-tension buses and supplied from either the main unit or the transmission lines. Means have been provided, in the way of a "flop-over" or "voltage-chaser," automatically to transfer the important auxiliaries, like circulating pumps, hotwell pumps, etc., from either source of supply to the other in case one goes dead.

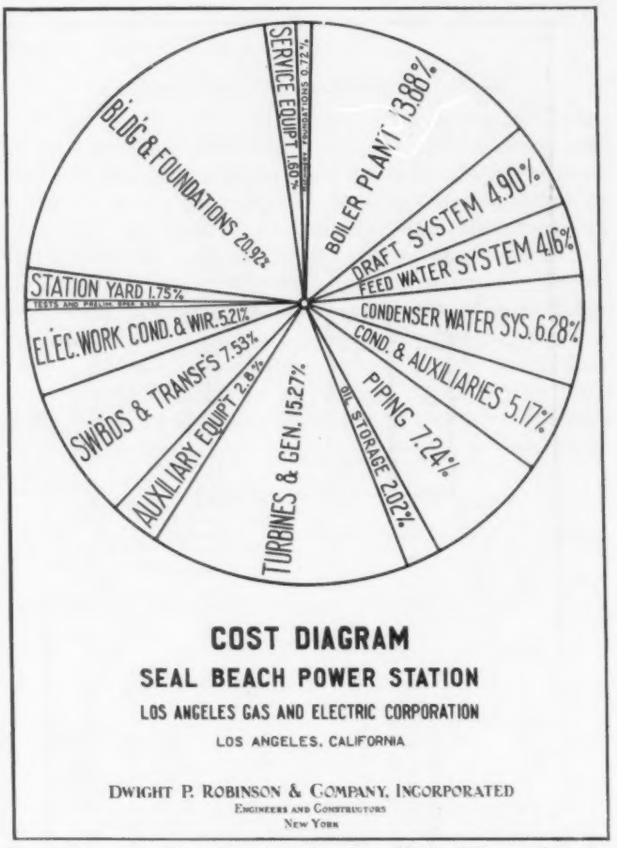
With the exception of one steam boiler feed pump and the duplex exciters which have both motor and turbine drives, all auxiliaries are electrically driven —the large motors at 2,300 volts and those below 75 hp. at 440 volts. The steam-driven units permit starting up a dead plant if outside power is not availble.

No Low-Tension Buses

The fact that all the power, except that used in the station itself, is used in Los Angeles, requires for economical transmission a relatively high voltage; 110,000 volts was adopted. Since this does away with all distribution at generator voltage, all buses at that voltage have been eliminated and the generators are connected direct to the step-up transformers through an oil switch. This switch is for synchronizing only and may be eliminated after further experience is had in synchronizing with high-tension switches. By this layout the design is simplified and the cost reduced.

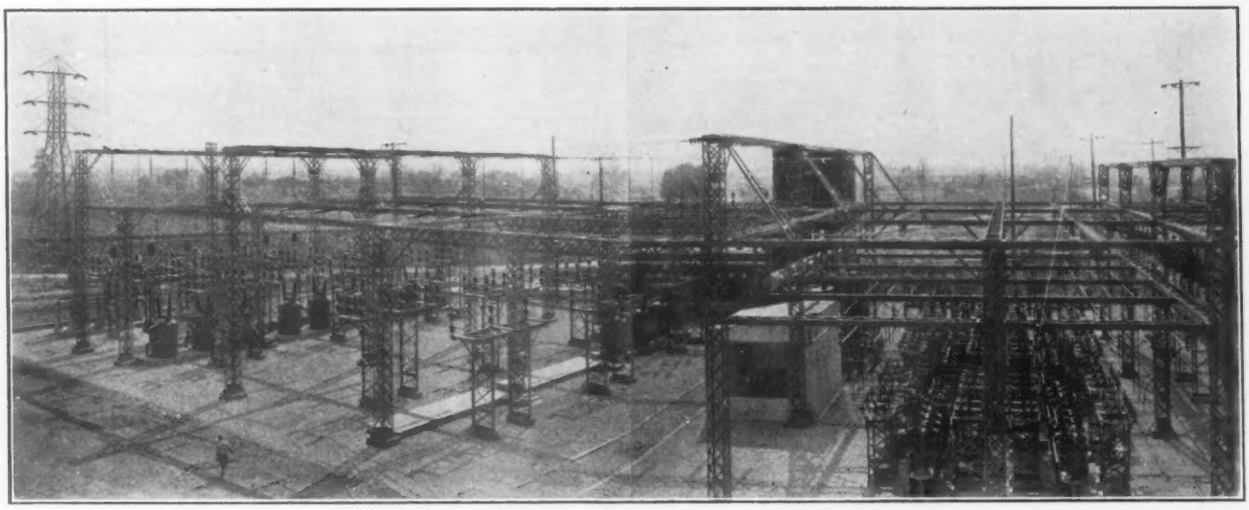
Direct current is used for excitation and for the circuits controlling oil switches only, thus eliminating most of the converting equipment. Variable speed is required for boiler feed pumps and forced-draft fans. The former are driven by wound-rotor motors as only small variation is necessary, while the latter, requiring a larger speed range, connect to brush-shifting adjustable speed induction motors.

On account of the extreme severity of salt fogs, all high-tension equipment has been housed and the maximum reliability thereby secured. The accompanying cuts of photographs and drawings give an idea of the arrangement and connections. A detailed description of the plant, giving capacities of apparatus, manufacture, etc., will appear in a future issue of this Journal.



Cost diagram. The investment cost will be $85 per kw. for the completed two-unit station

The Seal Beach plant was designed and constructed under the immediate direction of A. B. Day, vice-president and general manager of the Los Angeles Gas and Electric Corporation, assisted by H. J. Kister, manager of operation and construction, and J. G. Rollow, electrical engineer. Dwight P. Robinson & Company, Inc., acting as agent, has executed the work, including the transmission lines and substation connected therewith.



View of the East Side substation from the roof of the cooling tower

Rural Electrification in California

By Ben D. Moses[1] and George C. Tenney[2]

CALIFORNIA'S record in rural electrification is not approached in any other section of the country. Approximately 60 per cent of its farms receive electric service. Many factors have contributed to this achievement. In this article the authors discuss the progress which has been made to date and the work which is being done by the California Committee on the Relation of Electricity to Agriculture.

APPROXIMATELY 60 per cent of the farms of California receive electric service in one form or another from the lines of the various power companies of the state. This high average reflects quite conclusively the true progress being made in the application of electricity to California agriculture. Rainfall cannot be depended upon entirely for the satisfactory growing of the state's major crops, and as a consequence there has been a big development of artificial irrigation. Pumps have been installed for raising water from lakes, streams and wells and for the drainage of large areas after flooding. The U. S. census for 1920 showed that 295,672 acres were irrigated with water pumped from streams, 60,278 acres from streams by combined pumps and gravity, 826,846 acres with water pumped from wells, 23,561 from wells by combination flow and pumping and 4,168 acres by water pumped from lakes. The electric motor, furnishing as it does a dependable and efficient means of drive at a reasonable cost, has been adopted generally for driving these pumps.

The irrigation load has been sufficiently large to warrant the construction of rural extension lines, and this has made power available to the farmer for other purposes. Pumping also is a seasonal and peak load so that it has been to the advantage of the power companies to encourage other uses on the farm and to assist in the development of new applications so as to fill in the valleys in the load curve and to produce a higher load factor.

The farmer himself has not been slow to adopt the many conveniences that electricity affords, not only about the farm itself, but also in the home. The farmer with his demand and the power company with the supply form a good combination provided the connecting link of cost to the farmer and revenue to the power company is reasonable. Lighting, agricultural power, and cooking and heating schedules, as well as rural-line extension rules, have been arranged by the California State Railroad Commission so as to assist in the economic solution of the problem. The alacrity of the farmer, the efficiency and dependability of the service, and the reasonableness of the schedules have resulted in a wide application. In the case of farm homes it is not uncommon to find houses with a connected load of 10 kw. or more.

A study of the rural operations of the power companies of the state now is being made by the California Committee on the Relation of Electricity to Agriculture. When this survey is completed there will be a record of the number of agricultural consumers using electricity for lighting, for heating and cooking and for agricultural power. The statistics also will show the number of farmers receiving central-station service, the total number of miles of rural extensions, the annual agricultural consumption, and the revenue from this load. When available, these results will be published in the Journal of Electricity.

It is felt that the information to be derived from this study will aid not only the California companies in the extension of their agricultural operations but also will be of great assistance to companies in other sections of the country where efforts are being made to establish rural service.

The California Committee on the Relation of Electricity to Agriculture, in order to carry out its studies, has divided its work into two general classifications, "domestic" and "production." The object of electricity in the first case is to reduce the drudgery and increase the comfort in the farm home, and in the second to increase production, reduce operating costs and improve the quality of the product upon the farm itself.

TABLE I—What the Farmer Wants to Buy

(After each item is the percentage of farmers out of the total group who desired that particular one. The items are arranged in order of preference.)

Water systems	10.2 per cent
Radios	9.2 per cent
Washing machines	6.6 per cent
Lighting systems	6.5 per cent
Incubators	6.1 per cent
Oil stoves	5.2 per cent
Kitchen cabinets	5.2 per cent
Heating systems	4.3 per cent
Cream separators	4.3 per cent
Motor trucks	3.4 per cent
Tractors	3.4 per cent
Vacuum cleaners	2.7 per cent

Electricity has proved a boon to the farm housewife, and she has been quick to recognize the convenience and practicability of the many appliances. Its popularity is indicated by the results of a recent survey conducted by one of the national farm magazines. Farmers were asked to specify the equipment most desired in their individual cases. The first four items (see Table I) are typically domestic, and seven of the thirteen are electrical. It must be remembered also in connection with the table that the

[1] Executive Secretary, California Committee on the Relation of Electricity to Agriculture.

[2] Managing Editor, Journal of Electricity.

survey was national in scope and does not apply specifically to California conditions. As further evidence of the favor with which electrical appliances are received in the home, the Electric Cooking and Heating Committee of the Pacific Coast Electrical Association estimates that there are 21,000 electric ranges in the homes of California and that about 8,000 of them are in farm kitchens. One of the larger power companies reports that 90 per cent of the ranges on its lines are on farms.

It may be stated with assurance that few of the homes within reach of central-station service do not have electric lights, a washing machine, vacuum cleaner, iron and other appliances. Seventy-five per cent of the farms in the state have running water,

	ELECTRIC MOTOR USED FOR	TOTAL No.	TOTAL H.P.		ELECTRICAL HOUSEHOLD APPLIANCES	No.		ELECTRIC LIGHTS	No.
1	Irrigation			20	Range		38	Residence Lights	
2	Water Supply			21	Hot Water Heater		39	Barn Lights	
3	Feed Cutter			22	Washing Machine		40	Shop Lights	
4	Silo Filler			23	Space Heater (Stove)		41	Dairy Lights	
5	Shop			24	Sewing Machine		42	Pump House Lights	
6	Wood Saw			25	Vacuum Cleaner		43	Poultry House Lights	
7	Milking Machine			26	Flat Iron		44	Yard Lights	
8	Cream Separator			27	Mangle		45	Garage Lights	
9	Refrigerator			28	Percolator		46		
10	Dehydration Fan			29	Toaster		47		
11	Ventilator Fan			30	Waffle Iron			MISCELLANEOUS	
12				31	Table Grill (Stove)				
13				32	Curling Iron		48	Electric Truck	
14	Total Number Motors			33	Immersion Heater		49	Horse Clippers	
15	Total H.P. Connected Load			34	Heating Pad		50	Sheep Shears	
16				35	Dish Washer		51	Blender	
17	Number Acres Farmed			36	Portable Fan		52	Incubator	
18	Major Crop			37	Bell Transformer		53	Battery Charger	
19									

Other Uses and Remarks

CARD No. 28

Facsimile of postcard questionnaire being sent out to all rural consumers by the California power companies

and in many cases the water is furnished by automatic electrically driven pumps.

Household refrigeration is a new use that is being developed. The farmer wants a satisfactory system of cooling that he can afford both to buy and operate. These plants must be reasonable in price, have low operating costs, and be sufficiently substantial that depreciation will be low. As with other appliances, service is going to be the prime requisite.

The exact extent to which electricity is used in the farm household, as well as on the farm itself, will be known when a survey now under way is completed. A sample of a postcard questionnaire which is being sent by the power companies to all rural consumers is shown in an accompanying illustration.

Considerable interest has been aroused in better farm home lighting by a portable demonstration given by the University of California Agricultural Extension Division. An exhibit has been prepared and talks are given by a department specialist before farm-center meetings. The assembled exhibit is shown in an accompanying illustration.

In order to understand how electricity is serving the California farmer from a production standpoint it is necessary to investigate the various applications. Pumping was not only the first but is also the most general application of power. A. G. Wishon, of the San Joaquin Light & Power Corporation, claims the honor of having installed the first irrigation motor on a farm in the San Joaquin Valley 25 years ago. It is estimated now that in excess of 900,000 acres of land are irrigated by electric power in the state, and that the number of agricultural power users is approximately 37,500. Practically all of these are customers using electric motors to drive pumps. Studies made by an individual power company of motor performance in 2,000 pumping plants showed that the average capacity of each irrigation motor was 12.5

Irrigation pumping plant in the San Joaquin Valley. By pumping into a reservoir the farmer is able to maintain a better load factor and use a smaller motor because the plant can operate 24 hours a day.

hp., the average water lift was 40.7 ft. and the average amount of water delivered by each plant per season was 198.7 acre-ft. This water cost the farmers on an average of $1.29 per acre-ft. A map of a typical farming area showing the number and location of pumping plants is presented in an accompanying illustration.

Some power companies of the state are working with the farmer in improving pump performance and cutting down pumping costs by conducting pump-testing departments. Tests are run for the farmer that show the efficiency of his pumping plant, and suggestions are made for improving this efficiency if it falls below the proper standard.

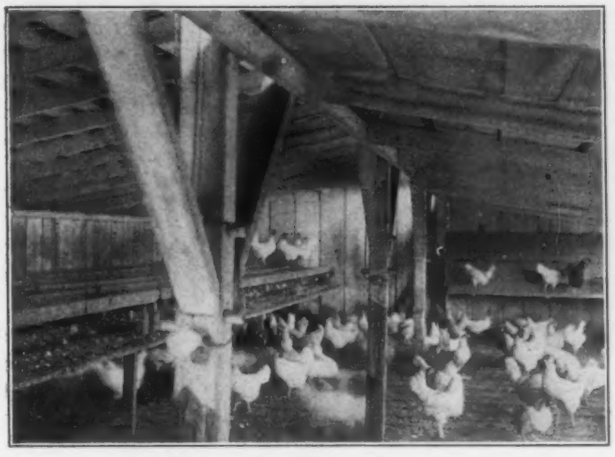
Eggs being inspected before being placed in electric incubators at the Must-Hatch Hatchery at Petaluma, the largest in the world

TABLE II—Preliminary Results of Tests of Electric Brooders

	GENERAL			CHICKENS		BROODER			HOUSE				RESULTS		
Test no.	Business*	Location†	No. acres	Total No. in flock	No. baby chicks	Number	Type‡	No. chicks	Type	Size rooms in (ft.)	Runways	Exposure	Total hrs.	Total kw.-hr.	Watts per chick per hour
1	P	Pet	5	15,000	7,600	24	N	300	Shed	12x14	Field	S	672	257.0	1.275
2	P	Pet	5	15,000	7,600	24	N	400	Shed	12x14	Field	S	672	187.2	.696
3	P	Pet	5	15,000	7,600	24	N	400	Shed	12x14	Field	S	672	152.3	.5666
4	P	Pet	5	15,000	7,600	24	N	400	Shed	12x14	Field	S	672	212.0	.7887
5	P	Pet	5	15,000	7,600	24	N	None	Shed	12x14	Field	S	672	293.0	.....
6	P	Pet	20	25,000	.....	..	N	400	Gable	.....	.....	..	480	101.5	.5286
7	N&P	SR	90	5,200	3,000	6	N	1,200	Gable	15x16	Field	..	552	49.0	.074
8	N&P	SR	90	5,200	3,000	6	N	1,200	Gable	15x16	Field	..	552	49.0	.074
9	Far	SR	60	4,000	2,600	3	N	900	Shed	14x16	36x50	NE	552	118.5	.238
10	Far	SR	60	4,000	2,600	3	N	900	Shed	14x16	36x50	NE	552	155.0	.312
11	F&P	SR	20	6,000	3,000	3	G	950	Gable	18x22	Yard	S	528	383.0	.763
12	P	Seb	5	.....	.....	..	N	175	Shed	8x12	8x50	E	528	63.0	.682
13	F&P	H	60	3,000	2,000	2	G	1,000	Shed	16x20	Yard	S	...	.....	.....

*P=Poultryman; N=Nut grower; Far.=General farmer.
†Pet.=Petaluma; SR=Santa Rosa; Seb.=Sebastopol; H=Healdsburg.
‡N=Non-glowing; G=glowing or radiant.

Electricity is making rapid strides in its application to the poultry industry, because of its facility for automatic control, its cleanliness, its uniformity and its low fire hazard. Practically all of the chickens hatched on a large scale in California today are produced in electric incubators. Electric brooding has become sufficiently popular so that two large concerns are now building electric brooders and the poultryman is finding that the same advantages that applied in the case of electric incubation apply to electric brooding. The one notable objection—the possibility of an interruption of service which might prove harmful to the brood of chicks—is becoming relatively unimportant because of the dependable service being rendered by the power companies. Many of the troubles experienced in the early designs of electric brooders rapidly are being overcome by proper ventilation.

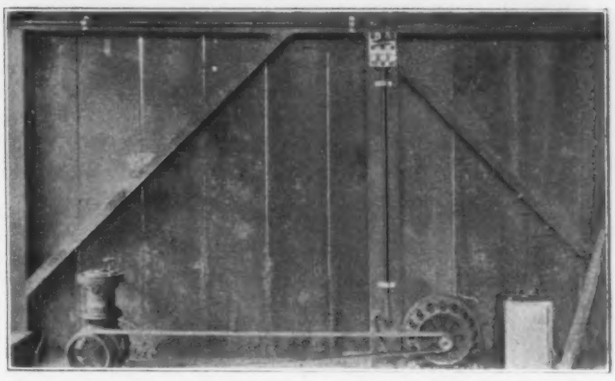


Hens in an electrically lighted poultry run. Lights are used during winter months to increase egg production

Tests made by the California Committee on the Relation of Electricity to Agriculture show that electricity for operating brooders under California conditions is from 50 to 75 per cent cheaper than other types of fuel. These tests show that it costs from one and one-half to two cents to brood a chick electrically over a period of six weeks. Table II shows preliminary results of tests conducted on thirteen different electric brooders in the Petaluma-Santa Rosa poultry-raising district.

The use of artificial lighting during winter months to increase egg production when prices are high is so common that it is felt that this field needs little further study. Needless to say, many of the large poultry farms have equipment of this character, and some of the farmers have developed this application even to the extent where dimmers are used on the lights in the evening to simulate the approach of dusk, it having been found that when the lights were turned off suddenly and the hens left in the dark they were so confused that many would fail to get on the roosts. Time switches are used for turning on and shutting off the lights.

The portable home lighting exhibit used by the University of California Agricultural Extension Service for giving talks before farmers on better home lighting



A 3-hp. motor driving a compressor which operates three milking-machine units

The problem of cleaning the chicken houses is one that may lend itself to the application of heavy-duty

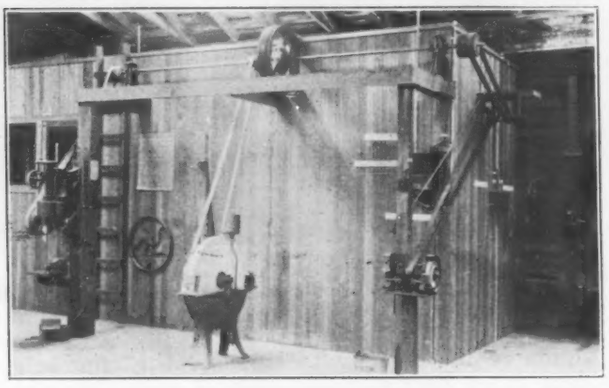
TABLE III.—Tests of Electric Spray Rigs.

Items	Test Number								
Tabulated	*1	2	3	**4	5	6	7	8	9
Size ranch, acres	30	260	250	56½	50	40	50	130	130
Number trees	2,270	20,200	22,000	4,300	5,000	4,000	5,000	10,100	10,100
Age trees—yrs	5 to 40	2 to 20	15 to 34	3 to 60	23	35	23	2 to 20	2 to 20
Spacing trees—ft	24x24	20x20	20x20	16x16	16x24	16x20	16x24	20x20	20x20
Pump location	Corner	Center	Center	Corner	Corner	Side	Corner	Center	Center
No. pump cyl	3	4	3	3	3	3	3	3	4
Bore—in	3	3¼	3¼	3¼	3¼	3	3¼	3¼	3¼
Size of motor	15 hp	7.5 hp	10 hp	35 hp	10 hp	5 hp	10 hp	7.5 hp	7.5 hp
Trees sprayed per acre	75.6	109	109	170	114	136	114	109	109
Trees sprayed per day	756	2,020	2,200	1,230	1,000	800	1,000	1,444	1,444
Acres sprayed per day	10	18.5	20.2	774	878	5.88	8.78	13.24	13.24
Trees sprayed per hr	84	202	220	123	100	80	100	144.4	144.4
Acres sprayed per hr	1.11	1.85	2.02	.774	.878	.588	.878	1.324	1.324
Trees sprayed per man per hr	14	6	8.75	20	20	26	20	9.0	9.0
Acres sprayed per man per hr	.185	.308	.33	.138	.175	.196	.175	.147	.1475
Load power factor	34.0	80.0	74.0	54.1	80.9	74.8	80.9	81.5	80.7
Horse power used	4.10	5.68	4.63	12.01	8.48	3.17	9.36	7.29	8.24
Cost system per acre	$58	57.70	40.00	106.30	37.50	....	37.50	57.70	57.70
Cost per tree	$.767	.53	.367	.625	.320	....	.320	.53	.55

*Designed for 150 acres. Installation not complete.
**Uses large irrigation motor in same pump house. Initial cost high due to large motor and remodeled plant.

vacuum cleaning apparatus such as is used in hotels. The poultry men are waiting to be shown whether this equipment can be applied successfully.

In the orchards of California electricity is finding new uses aside from pumping. One of the most recent developments is stationary spraying. Nine installations covering approximately 1,000 acres have been studied by the committee. Facts discovered in these studies show that the orchardist can



A farm shop of the type recommended by the committee

spray under adverse ground conditions and that the ability to spray promptly and quickly is an important factor in the "bringing in" of his crop. Installation costs average approximately $55 per acre and are as low as 30 cents per tree. Motors range between 5 and 10 hp. for this service. The use is seasonal, but since it precedes the irrigation load it gives a better general load factor for the farm. While the committee has no definite figures on operating costs as yet, the indications are that spraying with this type of equipment will be comparatively low. Table III gives the results of studies of this subject to date.

A possible field of application which will require considerable study is the dehydration of fruits and nuts. Marked success has been experienced with oil-fired dehydrators, and one successful installation has been made with electricity furnishing the heat for the dehydration of walnuts. The problem is one of a design which will permit economic operation. The committee is making a tabulation of the physical properties of the various fruits and nuts which are dehydrated in the state, with an idea of having on hand data which will be of use in the design of electric dehydrators at some later date.

The California dairyman has found a number of applications of electric power in addition to his pumping requirements. Electric milking machines are being used successfully in many of the large dairies. Seven dairies where milking machines supplanted hand milking were studied by the committee, the herds varying from 20 to 420 cows and the milk production from 18.5 to 29 lb. per cow. The average energy consumption per day per cow was .076 kw-hr. The average cost of energy per cow per month was $.0455 on the basis of an energy rate of 2 cents per kw-hr. The average energy cost per 100 lb. of milk was $.0065. The results of this study are shown in Table IV.

In a recent survey made by the chief of the State Bureau of Dairy Control the majority of the district dairy inspectors stated that the thing most needed by the dairy industry at the present time was an electric sterilizer which would furnish sufficient hot water for washing pails and cans and sufficient steam

TABLE IV.—Tabulation of power requirements of electric milking machines on seven dairies.

Dairy No.	No. of units	No. cows per unit	No. of cows	Amt. milk per cow per day lb.	Elec. per day per cow kw.-hr.	Elec. per day per 100 lb. milk kw.-hr.	Elec. cost per cow per month	Av. milking time per cow per day in min.	Power cost per 100 lb. milk*
2	10 D	42	420	20.6	.033	.16	$.02	10.38	.32c
6	2 D	60	120	18.5	.050	.27	$.032	.....	.54c
7	2 D	43	86	19.2	.038	.198	$.023	8.406	.39c
1	4 S	12	48	22.7	.075	.33	$.043	12.09	.66c
3	2 D	19	38	22.6	.0816	.36	$.048	12.76	.72c
5	2 S	14	28	23.8	.112	.47	$.066	.....	.96c
4	1 D	20	20	29.0	.145	.50	$.087	15.34	1.00c
Average	.....	.....	.....	23.2	.076	.327	$.0455	11.795	.....

*Assuming a power cost of 2c per kw.-hr. which is about the average rate paid.

for sterilization. Manufacturers are having some success with the development of this type of equipment. Electric refrigeration is also a field for development in the case of the small dairies of the state. It is already widely used in the big dairies.

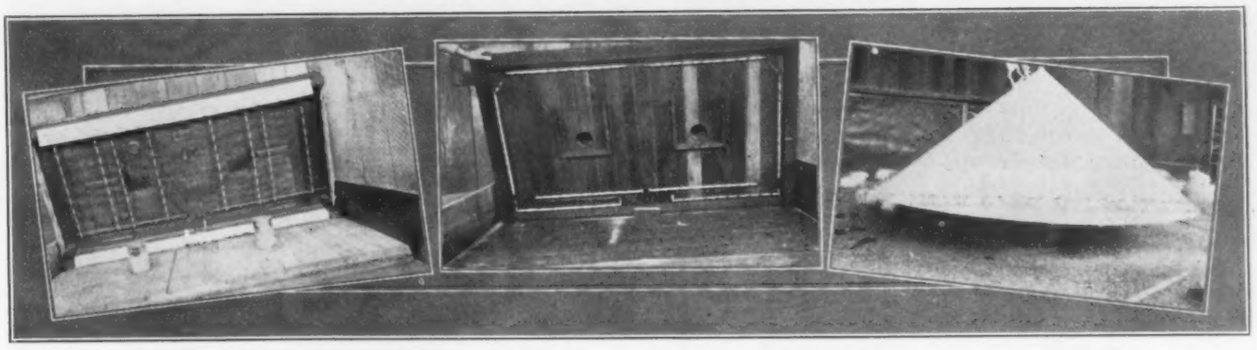
Spraying half a mile from the spray house where a motor drives the spray pump. The difficulty of using a portable rig can be realized when the height of the grass is noted

While the work of the committee has shown that the principal agricultural users of electricity, aside from the home, are the poultryman, the orchardist, the dairyman and the farmer requiring pumped water for irrigation, there are several miscellaneous uses for general farming which might be mentioned. The greatest need is for a portable motor between 5 and 10 hp. in capacity for utility purposes. If the problem of transmission of energy to various parts of the farm can be solved, the farmer can use a motor of this size which can be transported from place to place. Such a motor would cut down his initial investment in electrical equipment and decrease his demand charge because one portable motor would do the work of two or three stationary. In some instances he is holding down his demand charge by installing a double-throw switch for two motors used for different purposes.

Through its cooperation with the farm mechanics teachers throughout the state the committee is encouraging the construction of a modern and convenient farm workshop with an electric motor installed. One of the accompanying views shows a shop of the type recommended.

The committee has found that the farmer will use electricity where it will perform a service either better or cheaper than other forms of power or where it will improve the quality of the crop he is producing. The electrical industry in the past has looked upon the problem as one of education of the farmer. This is not the case in the strictest sense of the word. The problem of rural electrification seems rather to consist of—first, the education of the electrical industry to the needs of the farmer; second, education of the farmer to the possibilities of electricity; and third, cooperation between the farmer and the electrical industry in the production of proper machinery and its use.

Although rural electrification has developed in California faster than in other sections of the country, there is still much to be done, and there are many applications for the economical use of electricity. Mutual cooperation between the power companies, the manufacturers and the farmers will solve these problems to the advantage of all. The California Committee on the Relation of Electricity to Agriculture is working on these problems at the present time, fixing its attention not on generalities but upon specific applications. This work is expected not only to develop facts and information which will be of value to the electrical industry and farmers of California but also because of the extent of rural electrification in that state, to furnish data which will guide and assist the industry and the farmers in other sections of the country where steps are being taken to provide adequate electrical service to the farm.



Two types of electric brooders. The views on the left and in the center show the top and bottom, respectively, of a non-glowing or black heat type. The picture on the right shows the glowing or radiant type

General view of mill of Carlisle-Pennell Lumber Company, Onalaska, Wash., with log pond in the foreground

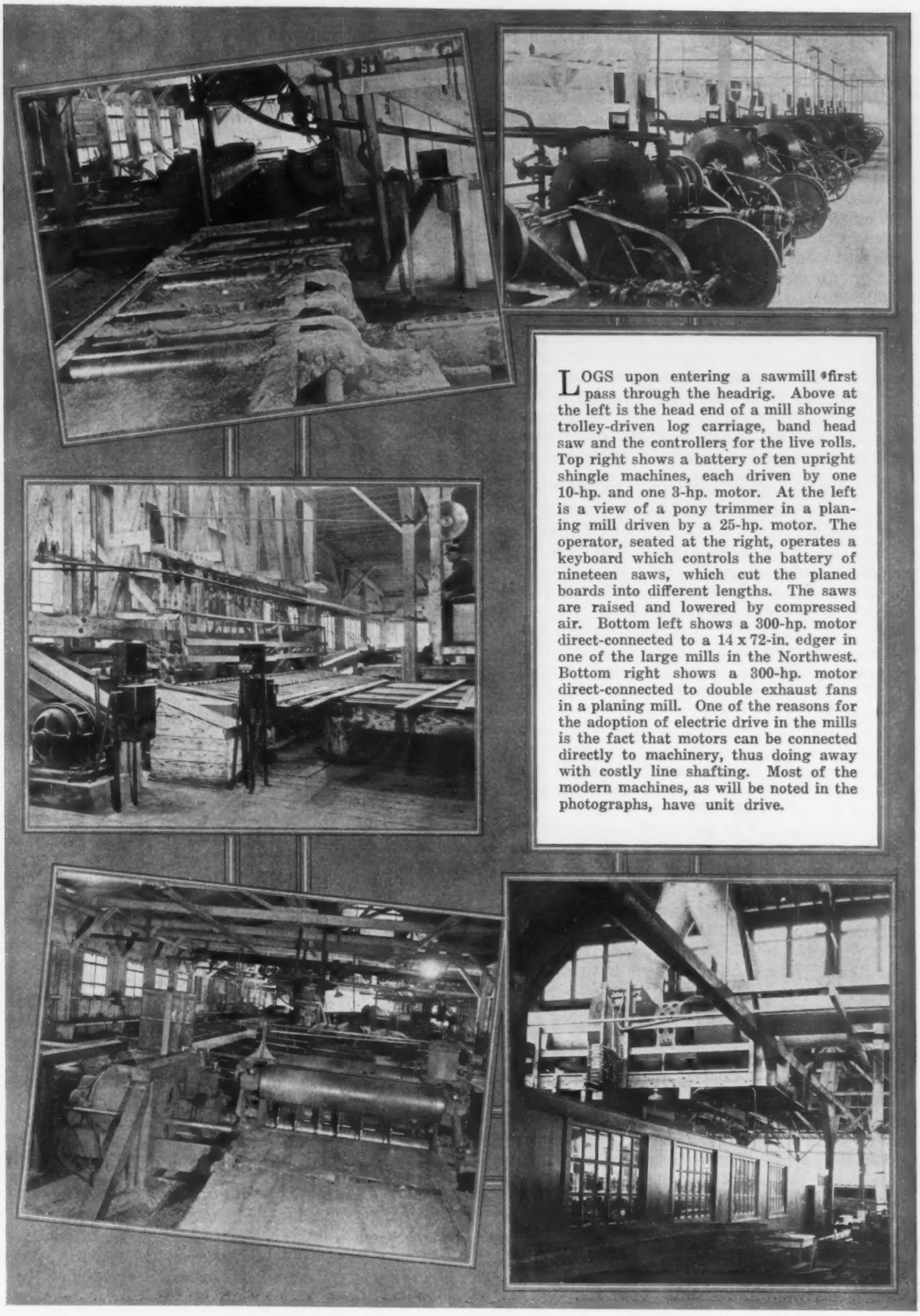
The Lumber Industry—A Potential Utility Load

By E. F. Whitney
Manager, General Electric Company, Portland, Ore.

IN recent years great advances have been made in the electrification of the lumber industry in the Northwest, but the bulk of the energy consumed in the production of lumber in this territory is generated by the mills themselves. The possibilities in the field are discussed here by a man who has made a study of the situation.

LUMBERING is one of the most important industries on the Pacific Coast and a particularly vital business to the northwestern states of Washington and Oregon. One-third of the country's reserve of standing timber lies in these two states, so it is but natural that the lumber production of these states must continue to increase at a rapid rate in order to supply the deficiency resulting from reduced production in the South, East and Middle West as the available timber stands of these districts become exhausted. Only a few years ago the total lumber production of Oregon and Washington was less than 6,000,000,000 ft. per year. In 1920 it was approximately 7,500,000,000 ft., and in 1924 it has been estimated at 9,500,000,000 ft.

The increase in the last four years has not been so rapid as was predicted. The remaining supply of southern timber, while diminishing, is not being exhausted at the rapid rate that estimates of five years ago indicated. This, in some measure, is due to the conservation program being followed by southern manufacturers. Some large operators of the South hope that, with their reforestation plans in complete operation, they will have practically a continuous timber-producing unit, and in fact, present indications are that the South will continue to be an important lumber-producing section for a number of years. However, continually increasing demands will be made on the timber reserves of the Northwest to supply the gradually diminishing



LOGS upon entering a sawmill first pass through the headrig. Above at the left is the head end of a mill showing trolley-driven log carriage, band head saw and the controllers for the live rolls. Top right shows a battery of ten upright shingle machines, each driven by one 10-hp. and one 3-hp. motor. At the left is a view of a pony trimmer in a planing mill driven by a 25-hp. motor. The operator, seated at the right, operates a keyboard which controls the battery of nineteen saws, which cut the planed boards into different lengths. The saws are raised and lowered by compressed air. Bottom left shows a 300-hp. motor direct-connected to a 14 x 72-in. edger in one of the large mills in the Northwest. Bottom right shows a 300-hp. motor direct-connected to double exhaust fans in a planing mill. One of the reasons for the adoption of electric drive in the mills is the fact that motors can be connected directly to machinery, thus doing away with costly line shafting. Most of the modern machines, as will be noted in the photographs, have unit drive.

production of other sections, and, as conditions require, the Northwest must expand its production to meet the trade demands of the world. This does not necessarily mean a large increase in the number of existing mills, but it does signify a greater production for existing mills and the addition from time to time of large milling units which will be erected by those lumbermen that transfer their scene of operation from other sections to the Northwest.

Ten to twelve years ago there was in operation a number of what would be considered today small-capacity mills. In 1910 a standard sawmill unit was assumed to have a capacity of about 100,000 ft. per day, or an annual production of 28,000,000 to 30,000,000 ft. Today the tendency is toward a smaller number of manufacturing units with the arbitrarily assumed standard mill producing probably 160,000 ft. per day, or 40,000,000 to 45,000,000 ft. per year. The trend therefore is toward larger manufacturing units, a smaller number of which will give greater production, and, of course, in general the larger the manufacturing unit the more efficiently will such units be designed and constructed.

Trend Toward Electrical Operation

A large mill cannot afford to use any other motive power than electricity. The first cost of a large electric mill is no higher and often is less than the first cost of a steam-engine, belt-driven mill of equal capacity. But a small mill with a capacity of 25,000 to 40,000 ft. per day cannot, as a rule, be built for electric drive as cheaply as a steam-driven mill. In both cases the first cost referred to covers the complete mill installation, including boiler plant in the case of steam drive and power plant in the case of electric drive. The reason for the higher first cost of the small electric mill is evident, but when such mill is located favorably within reach of central-station power, the necessity of a generating unit is removed and the electric mill can be constructed for as low a first cost as the steam mill.

Since the tendency in milling operations is toward larger units, and since in the larger units electric drive has proved economical, it may be said that the general tendency of the lumber industry is toward electric drive. In fact today every new modern sawmill is designed and built to use electric power practically without controversy as to the feasibility of using steam. Since the electric mill requires a supply of power which either must be generated by the mill or be purchased from available utility systems, the potentialities of load development in this field are increasing rapidly.

Possibilities from Central Station Standpoint

To produce and finish the 9,500,000,000 ft. of lumber estimated to have been manufactured in the Northwest in 1924 would require approximately 500,000,000 kw-hr. Of this total lumber production approximately 46 per cent was produced by the use of electric power, which leaves a possible load development of 270,000,000 kw-hr., the greatest part of which is available to existing lines of utility systems as potential additions to their present loads. This assumes, however, that none of the existing electric mills, a great number of which now generate their own energy, will be converted to the use of central-station energy, but I believe that in time a considerable portion of this present use of 230,000,000 kw-hr. will be supplied from the utility systems of the Northwest. The history of almost every sawmill is one of constantly increasing power demand, and when the limit of the present generating equipment of these mills is reached and additional load is added, the surplus can be taken care of most economically by central-station service.

Table of General Statistics on Lumber Industry

(Approximate Figures.)

Total production, Washington and Oregon, 1924	9,500,000,000 ft.
Distribution by districts showing principal producing centers—	
Oregon—	
Portland and Columbia River	1,641,165,000 ft.
Coos Bay and Coquille River	384,973,000 ft.
Klamath Falls	266,296,000 ft.
Washington—	
Seattle district	481,100,000 ft.
Tacoma district	1,059,835,000 ft.
Everett district	912,982,000 ft.
Bellingham district	409,300,000 ft.
Grays Harbor	1,261,600,000 ft.
Willapa Harbor	222,600,000 ft.
Total electrical energy required to manufacture entire production of these two states	500,000,000 kw-hr.
Per cent of total production electrified	46
Per cent of total number of mills electrified	9
Total electrical energy required to yard and load entire log production of these two states	145,000,000 kw-hr.
Per cent of total log production electrified	3.4

It is interesting to note that while approximately 46 per cent of the total lumber output of Oregon and Washington is produced with electric power, only about eight and a half to nine per cent of the total number of sawmills in these two states uses electric power, excluding a number of mills having only one or two motors installed for specific duty. The inclusion of these probably would double this percentage.

A study of the relative locations of these mills may be of interest. About 65 per cent of the total lumber production is contributed by mills located on tidewater and at or near the shipping centers, as Portland and the Columbia River, Coos Bay, Seattle, Tacoma, Everett, Bellingham, Anacortes, Grays Harbor and Willapa Harbor. All of these localities now have adequate utility service, and it will be a natural development that in time a considerable number of the mills located here will take advantage of the convenience and economy of central-station service. Of course it also happens that about 30 per cent of the mills in these same districts at present are electrified, but, nevetheless, a large percentage is still left as prospective profitable load.

Logging Presents a Large Field

The logs from which this lumber is produced must be gathered from their place of growth in forests and transported to the mills also by the use of power. This is almost a virgin field for load development. If all the logging operations of Oregon and Washington

possibly could be electrified for only that part of the work involving hauling the log from the place where it is felled and loading it upon the flat car, this alone would require about 145,000,000 kw-hr. per year. At present the electric logging in the two states uses about 5,000,000 kw-hr. per year, less than three and a half per cent of the total production being produced electrically.

It is estimated variously that there are some 2,000 logging engines in daily operation in these two states, of which only thirty are operated electrically. The situation in this department of the lumber industry is substantially the same as that in the sawmill branch of the business, in that the greater portion of the output is produced by a relatively few large operators. Again the situation is comparable in that the large operators can afford to electrify under conditions that would be prohibitive to the small operators. It is likewise true that when power is available a greater saving can be effected from electrification of logging operations than obtains from electrification of the sawmill. Logging operations, however, are usually located more remotely, and this fact, I believe, has militated against a more complete investigation of the possibilities of serving them electrically. But mere remoteness should not prevent a complete economic survey, because there is now before us an example of the electrification of a logging operation involving the ultimate construction of sixty miles of 66,000-volt line. This company, having determined upon a program of electrification, built thirty miles of this line as an initial installation, and the economies effected have justified fully a continuation of the program adopted.

Three Stages of Development in Electrification

From the beginning, the history of electric application to the different operations of the lumber industry has been the same as in many other industries. At first it was largely a question of convincing the manufacturers of the advantages of electric drive. This stage has been passed completely; but, as in a number of other industries, and particualrly so in the lumber industry, because some steam is required for a part of the manufacturing process and because mill refuse provides apparently cheap fuel, practically all installations made during the first stage generated their own power in isolated plants.

Then came a consideration of the actual cost of this power, and in many instances, particularly those more favorably located, central-station service was shown to offer economies and conveniences which made the installation of the lumber company's isolated plant seem inadvisable. We have entered this second stage. With the large possibilities of profitable loads facing the utility companies, and the necessity for reduced manufacturing costs that faces some mill operators coupled, in some instances, with the necessity of increasing the power supply, both will give more intensive study to this problem which in the past was assumed to have been answered correctly without controversy. This naturally will lead to the third stage, to which we can look forward confidently—to that time when electric drive already having been proved the most economical power, universal central-station service will be accepted as the most economical source except in instances in which certain extraordinary elements perhaps may operate in favor of the isolated plant.

Review of the Activities of the Commercial National Section

By W. R. Putnam

Chairman Commercial National Section, N.E.L.A., Vice-President and General Manager, Idaho Power Company, Boise, Idaho

DURING the present administrative year, July 1, 1924, to June 30, 1925, the Commercial Section of the National Electric Light Association has held three conferences—the first at Chicago, Aug. 26 to 28, 1924; the second at San Rafael, Calif., Nov. 19 to 21, 1924, and the third at New York City, March 17 to 19, 1925.

In order to secure better results from the work of the section and more active participation by the commercial men of the industry in this work, special efforts of the officers of the section during the year have been directed toward the following matters of policy:

First, to secure a better realization on the part of commercial men and the companies that the work of the Commercial Section is intended to produce more and better business for the companies;

Second, that active participation by commercial men in the work of the section cannot help but produce better business for the companies these men represent;

Third, that as much work of the section as possible be performed by the subcommittees of the geographic divisions, thus insuring a much wider participation by the commercial men;

Fourth, that each committee center its activities as far as possible upon a few major subjects within the scope of that committee, thus having a definite objective for the work of the year, rather than attempting to cover all phases of the subjects included in the scope of the committee.

Former standing committees of the section—appliance, electric cooking and heating, power, lighting, transportation, and customers relations—were continued, and new committees to take up electric domestic refrigeration, industrial street and highway

lighting, and radio, and a new subcommittee of the power committee on commercial cooking and heating, were appointed.

The electric cooking and heating committee, under the chairmanship of A. C. McMicken, sales manager, Portland Electric Power Company, Portland, apportioned its work among the geographic divisions, assigning to the Northwest Electric Light and Power Association committee, under the leadership of Lewis A. Lewis, sales manager, The Washington Water Power Company, Spokane, a study of the characteristics of electric range loads for the purpose of securing more definite information than is now available to show the investment required on the part of electric service companies for handling this load. A special study of water heating was assigned to the Pacific Coast Electrical Association committee under the leadership of R. C. Bragg, Vallejo Electric Light & Power Company, Vallejo, Calif. To the Great Lakes Division committee, C. O. Dunten, Central Illinois Public Service Company, Springfield, Ill., chairman, was assigned a study of the costs of servicing electric ranges; and to a a special committee, of which C. E. Greenwood, Edison Electric Illuminating Company, Boston, is chairman, a study of the possible changes in wiring requirements with a view to reducing the cost of customers' wiring for range installations.

The industrial lighting committee, with J. F. Becker, United Electric Light & Power Company, New York City, as chairman, has prepared all details for an intensive campaign to be conducted in all industrial centers during the fall of this year for the purpose of securing additional use of electricity for industrial lighting purposes by present customers. The thought underlying the appeal to be used in this campaign is that better and more adequate lighting will decrease accidents, decrease spoilage of goods, and increase the output per man.

The appliance committee, Thomas W. Berger, The Philadelphia Electric Company, Philadelphia, chairman, and T. L. Phillips, Union Gas & Electric Company, Cincinnati, Ohio, vice-chairman, has produced some very excellent studies showing, first, the increased kilowatt-hour sales resulting from the use of various appliances by residential customers, and, second, the kinds of campaigns necessary to merchandise appliances successfully.

The electric domestic refrigeration committee, G. E. Miller, Cleveland Electric Illuminating Company, Cleveland, chairman, reports on the consumption of refrigerators, the costs of servicing, merchandising problems, ice cream cabinets, and individual water-cooling systems.

The power committee, with V. M. F. Tallman, Charles H. Tenney & Company, Boston, as chairman, devoted special attention to competitive waste-heat installations, as well as to other forms of competitive power including diesel engines. It also has studied the kilowatt-hour consumption per unit of product in various industries, and, through a subcommittee on commercial cooking and heating under the leadership of A. M. Lloyd, Commonwealth Edison Company, Chicago, is preparing a most exhaustive report on the subject of industrial heating.

The transportation committee, B. J. Martin, Commonwealth Edison Company, Chicago, chairman, has centered its work principally upon giving more publicity, both among electric service companies and among prospective users, to the desirability of the electric truck for certain transportation requirements, and to securing more active participation of electric service companies in the promotion of electric truck sales.

The lighting committee, C. C. Munroe, Detroit Edison Company, Detroit, chairman, early in the year spent its time furthering the work of the home lighting educational committee, and has given special attention to home lighting and commercial lighting requirements.

The street and highway lighting committee, with E. W. Lloyd, Commonwealth Edison Company, Chicago, as chairman, realizing that the growth of this class of business had not kept pace with the growth of population, has made special recommendations as to how commercial organizations of electric service companies should proceed to secure their share of this business.

The customers relations committee, F. F. Kellogg, Duquesne Light Company, Pittsburgh, chairman, has continued the monthly service suggestions and has given special study to the problem of the responsibility of commercial men in seeing that good customers relations are secured and maintained by the companies.

Due to the active participation of so many commercial men in the industry in the work of the various committees, unusually good results have been secured and most excellent reports have been prepared. These will be helpful to any commercial man studying the problem of how to direct the commercial activities of his company so as to secure the best results.

The Economy of Electric Trucks.—Electric trucks are outstandingly the most efficient and economical means of transportation where the short-haul, many-stop problem as it exists in metropolitan areas is to be met. Hills and even sandy roads no longer are the bogey that they once were. Notwithstanding these and others facts and figures, development and operation, there are today only about 500 electric trucks in operation in the state of California while there are 10,000 draft horses in daily use in the two cities of San Francisco and Los Angeles alone. On the basis that the average truck will do the work of a team of two horses, this tells us that there is a potential field for 5,000 electric trucks in these two cities, to say nothing of the many other Pacific Coast cities and towns. The main thing which seems to be lacking is a recognition of the potential and logical sales and application field that actually exists and is waiting for someone to wake up to the fact. While this vehicle will undergo the normal development of the times along with the other machinery in use, the period of experimentation is over and a finished product awaits the potential user. Not only is the electric truck the best available means of solving the transportation problem mentioned above, but it is a most excellent off-peak load builder.

Snook O'Brien's Model Diversified Electrical Farm

By John W. Otterson
Associate Editor, Journal of Electricity

THE farm of Snook O'Brien—some where in the San Joaquin Valley of California was laid out to show, through statistics and a miniature reproduction of the hypothetical farm, the relation of the cost of electricity to the gross returns when a number of crops are being raised on one farm. By securing this diversification a smaller installation is possible, greater load factor is secured, and the peak demand is reduced considerably, to the benefit of central station and consumer alike.

FROM the standpoint of the central station the electrification of the farm presents two problems that must be solved before the most satisfactory results can be obtained for the company and the consumer. In the first place, the development of this class of business must be accomplished to warrant the line extensions that are necessary. In the second place, after the business has been secured, the aim of the commercial department is so to diversify the demand that the period of use will come as close to the full year as possible.

From the point of view of the customer, the question that arises is, "How may I produce the greatest yield with the least expense?" The answer to this question also is affected to a great degree by the two problems that confront the central-station, for with a large agricultural load of a diversified character with a high yearly load factor lower rates per unit of power can be offered to the consumer.

Using this analysis, it can be seen readily that the interests of the central station and the agricultural consumer are identical, namely, the extension of electric service in agricultural districts and the diversification of demand so that a moderate-sized installation, working practically the year around, may be used to furnish the necessary power for the farm.

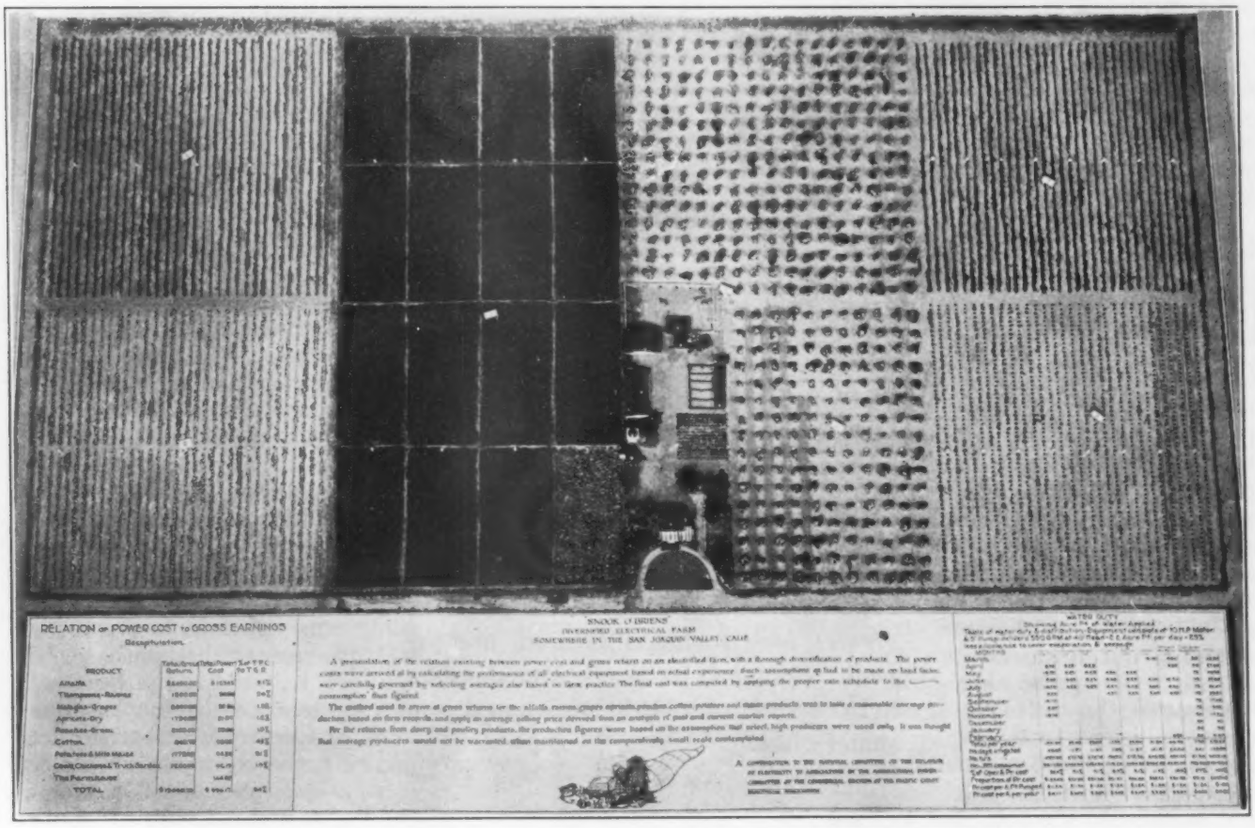
Looking toward the more extensive electrification of agricultural districts and the minimizing of the cost of power per unt of product, the agricultural power committee of the Commercial Section, Pacific Coast Electrical Association, at the suggestion of A. M. Frost, chairman of the section, has devoted considerable study to the problem. In its studies the committee reached the conclusion that to present the matter most forcibly to the agricultural consumer and the central-station commercial-department salesman, something more than the use of statistics would be necessary. The use of a model farm was considered, but it was agreed that such an exhibit presented without figures and facts thoroughly worked out would be of little value.

The aim of the leaders in the movement to prepare accurate statistics and visual data on the modern farm was so to present the information that it would be strikingly interesting to both the farmer and the central-station man. One of the reasons for the study was that it was deemed advisable to offer to the National Committee on the Relation of Electricity to Agriculture a comprehensive report on the relation of the cost of electricity to gross earnings from a model farm. This aim was one of the prime considerations in preparing the material which is to be contributed to the National Committee on the Relation of Electricity to Agriculture by the agricultural power committee of the Commercial Section of the Pacific Coast Electrical Association.

The plan finally adopted by the committee consisted in the preparation of a model farm, for which statistics and facts relative to the acreage, crop production, gross return and power costs were worked out. This model farm was laid out in miniature, using as the basis for the plan data collected over a period of years. The farm, considered to be located somewhere in the San Joaquin Valley of California, and known as "Snook O'Brien Diversified Electrical Farm," was so planned that by the diversified use of electrical energy, the installation would be kept running a great many months of the year; as a result Mr. O'Brien would get into the lower blocks of the agricultural power rate. On the model farm of Snook O'Brien it was possible to install a smaller plant than would have been necessary if the land had been planted to only one product. This was due to the fact that through the diversification of crops the irrigation season also is diversified as irrigation is not needed simultaneously by all of the crops. This procedure has a tendency to increase the load factor and to decrease the peak demand over that of the one-crop farm.

This increasing of the load factor and the decreasing of the demand is of course of vital interest to the central station for through these means the investment in plant capacity can be kept down, with the result that greater returns may be had on the capital invested.

In laying out the model farm of Snook O'Brien the crops to be raised in the various plots of the 80-acre diversified farm were decided upon after considerable study of the conditions existing in the San


RELATION OF POWER COST TO GROSS EARNINGS
Recapitulation.
"SNOOK O'BRIENS"
IRRIGATED ELECTRICAL FARM
SOMEWHERE IN THE SAN JOAQUIN VALLEY, CALIF.

The model of Snook O'Brien's farm is surrounded by the data shown in Tables I to X.

TABLE I.—Potato and Milo Maize Field, Field No. 1, 10 acres.

Average yield per acre	5 Tons potatoes 1½ Tons maize
Total yield	50 Tons potatoes 15 Tons maize
Selling price	$25 $35
Total return	$1775
Acre-ft. of water applied per year	44
Power cost per acre-ft.	$ 1.24
Power cost for water per acre per year	5.43
Total power cost per year	54.26
Percent of total power cost to total return	3.1

TABLE II.—Cotton Field, Field No. 2, 10 acres

Average yield per acre	750 Lb. seed ¾ Bale cotton
Total yield	3¾ Ton seed 7½ Bales cotton
Selling price	$25 $0.20
Total return	$843.75
Acre-ft. of water applied per year	31.2
Power cost per acre-ft.	$1.24
Power cost for water per acre per year	$3.83
Total power cost per year	$38.32
Percent of total power cost to total return	4.5

TABLE III.—Alfalfa Field No. 3, 20 acres

Average yield per acre	8 Tons
Total yield	160 Tons
Selling price	$15
Total return	$2,400
Acre-ft. of water applied per year	100
Power cost per acre-ft.	$1.25
Power cost for water per acre per year	$6.17
Total power cost per year	$123.45
Percent of total power cost to total return	5.1

TABLE IV.—Peach (Green) Orchard, Field No. 4, 10 acres

Average yield per acre	6 Tons
Total yield	60 Tons
Selling price	$35
Total return	$2,100
Acre-ft. of water applied per year	25
Power cost per acre-ft.	$1.24
Power cost for water per acre per year	$3.09
Total power cost per year	$30.86
Percent of total power cost to total return	1.5

TABLE V.—Malaga Grape Vineyard, Field No. 5, 10 acres

Average yield per acre	6 Tons
Total yield	60 Tons
Selling price	$40
Total return	$2,400
Acre-ft. of water applied per year	25
Power cost per acre-ft.	$1.24
Power cost for water per acre per year	$3.09
Total power cost per year	$30.86
Percent of total power cost to total return	1.3

TABLE VI.—Apricot (Dried) Orchard, Field No. 6, 7 acres

Average yield per acre	1¼ Tons
Total yield	8¾ Tons
Selling price	$200
Total return	$1,750
Acre-ft. of water applied per year	17½
Power cost per acre-ft.	$1.24
Power cost for water per acre per year	$3.05
Total power cost per year	$21.37
Percent of total power cost to total return	1.2

Joaquin Valley. All of the crops suggested are being raised there at the present time and have been found well adapted to the country. Seven fields and a farmyard were included in the model layout, the fields being devoted to raising potatoes and milo maize, cotton, alfalfa, peaches, Malaga grapes, apricots, and Thompson raisins. All of the fields with the exception of those set aside for alfalfa and the apricot orchard contained 10 acres each. The alfalfa field was twice the size of the others, and only 7 acres were set aside for the apricots.

After the crops to be raised on the Snook O'Brien farm had been decided upon, the engineering de-

TABLE VII.—Thompson Raisin Vineyard, Field No. 7, 10 acres

Average yield per acre	1½ Tons
Total yield	15 Tons
Selling price	$80
Total return	$1,200
Acre-ft. of water applied per year	25
Power cost per acre-ft.	$1.24
Power cost for water per acre per year	$3.09
Total power cost per year	$30.86
Percent of total power cost to total return	2.6

TABLE VIII.—Farm yard, 3 acres

10 Cows		
150 Hens		
Vegetable and truck garden—		
Total yearly yield	6,250 Lb. butter-fat 3,000 Doz. eggs $100 Garden truck	
Selling price	Butter-fat	$0.40
	Eggs	0.20
Total return	Butter-fat	$2,500
	Eggs	600
	Garden truck	100
		$3,200
Acre-ft. of water applied per year		7.5
Power cost per acre-ft		$1.24
Power cost for water per acre per year		$3.05
Power cost for	Milking machine, Separator, Sterilizer, Feed grinder, Yard lighting	per year $53.03
Total power cost per year		$62.19
Percent of total power cost to total return		1.9

partment of the San Joaquin Light & Power Corporation prepared a model of the 80-acre tract, and laid out, to scale, the various fields. Miniature reproductions of the crops to be raised were placed in the fields, and in the approximate center of the acreage the farmyard was situated. In the farmyard were located the house, garage, tank tower, barn and implement shed, separator house, poultry runs, milking shed, cutting shed, pump house, and alongside of the yard the truck garden. Everything that was placed on the model was made to scale so that the miniature, which is 4 x 8 ft., gives the impression of an aerial view of the farm.

TABLE IX.—Relation of power cost to gross earnings

PRODUCT	Total gross return	Total power cost	Percent of power cost to gross return
Alfalfa	$2,400.00	$123.45	5.1
Thompson raisins	1,200.00	30.86	2.6
Malaga grapes	2,400.00	30.86	1.3
Apricots—dry	1,750.00	21.37	1.2
Peaches—green	2,100.00	30.86	1.5
Cotton	843.75	38.32	4.5
Potatoes and milo maize	1,775.00	54.26	3.1
Cows, chickens and truck garden	3,200.00	62.19	1.9
Farmhouse	.....	144.00	...
Total	$15,668.75	$536.17	3.4

To present the information concerning the relation of the cost of electricity to the revenue of the farm, men from the San Joaquin Light & Power Corporation and others interested in this class of work in all branches of the electric power industry secured statistics covering the raising of the crops suggested as well as the costs of electricity needed. These data were compiled from averages as found in the San Joaquin Valley over a long period of years. The information secured dealt with the yields that might be expected, the average unit price, the acre-ft. of water needed to raise the crops, and the average cost for electricity for pumping the water. These data were secured for each crop, together with the amount of power and duration of the interval through which the power would be needed to raise the crops.

This information, covering the fields individually, was arranged in a series of tables to serve as a border for the farm itself. Tables I to VIII give the results as worked out for the seven fields and the farmyard. The gross returns from the various products raised were secured by taking a reasonable average production, based on farm records, and to this applying an average selling price derived from an analysis of past and current market reports. In figuring the returns from the dairy and poultry products, the production figures were based on the assumption that select high producers only were used, as it was agreed that average producers would not be practical on such a small scale.

The costs of operation for the pumping plant were figured on the regular agricultural power schedule for a 10-hp. motor. Under this schedule there is a demand charge for the year of $60. The energy charge is as follows:

1.4c per kw-hr. for the first 10,000 kw-hr. per year.
.9c per kw-hr. for the next 10,000 kw-hr. per year.
.7c per kw-hr. for the next 10,000 kw-hr. per year.
.6c per kw-hr. for all the remaining power.

The total power costs were calculated and then the costs were apportioned to each crop, according to the use as shown by the statistics secured from average installations of a similar nature. By comparing the total power costs with the gross returns for the va-

TABLE X.—Water duty on Snook O'Brien's diversified 80-acre farm

PUMP ELECTRICALLY OPERATED
10-hp motor—550 g.p.m.—2.2 acre-ft. per day—40-ft. head—25 percent loss allowance.

Months	Alfalfa 20 acres	Thompson vineyard 10 acres	Malaga vineyard 10 acres	Apricot orchard 7 acres	Peach orchard 10 acres	Cotton 10 acres	Potatoes and milo maize 10 acres	Truck garden, house, barn, milk sheds, etc. 3 acres	Total
Acre-ft. of water applied—									
March	....	....	....	....	....	16.0	6.3	.50	22.80
April	8.3	6.25	6.25	....	....	....	6.3	.50	27.60
May	16.7	6.25	6.25	4.38	6.25	....	....	.75	40.58
June	8.3	6.25	6.25	4.38	6.25	8.0	12.5	.75	52.68
July	16.7	6.25	6.25	4.37	6.25	3.6	6.3	.75	50.47
August	8.3	....	....	4.37	6.25	3.6	6.3	.75	29.57
September	16.7	....	....	....	....	....	....	.75	17.45
October	8.3	....	....	....	....	....	....	.75	9.05
November	16.7	....	....	....	....	....	....	.50	17.20
December	....	....	....	....	....	....	....	.50	.50
January	....	....	....	....	....	....	....	.50	.50
February	....	....	....	....	....	....	6.3	.50	6.80
Total	100.0	25.0	25.0	17.5	25.0	31.2	44.0	7.5	275.2
No. days irrigated	45.45	11.37	11.37	7.95	11.37	14.18	20.00	3.41	125.09
No. hours irrigated	1,090.80	272.76	272.76	190.92	272.76	340.32	480.00	81.84	3,002.16
No. kw.-hr. consumed	9,817.20	2,454.84	2,454.84	1,718.28	2,454.84	3,062.88	4,320.00	736.56	27,019.44
Percent of operation and cost	36.4	9.1	9.1	6.3	9.1	11.3	16.0	2.7	100.0
Proportion of cost	$123.45	$30.86	$30.86	$21.37	$30.86	$38.32	$54.26	$9.16	$339.14
Cost per acre per year	$6.17	$3.09	$3.09	$3.05	$3.09	$3.83	$5.43	$3.05	$4.24
Cost per acre-ft. of water	$1.24	$1.24	$1.24	$1.24	$1.24	$1.24	$1.24	$1.24	$1.24

rious crops it was possible to secure the per cent of the total power cost to gross earnings from each crop. The summation of this information is presented in Table IX. Unit power costs, including energy used for all purposes on the farm, average $0.0148 per kw-hr. Considering only the energy used for power purposes, the average price per kw-hr. is $0.01265.

Water-duty service data were made up also by taking the average of a large number of installations in the San Joaquin Valley. The total head as applied to the Snook O'Brien farm was taken as 40 ft., and the cost per acre-ft. of water was taken as $1.24. The amount of water needed was secured by taking the average as stated above. The 5-in. pump considered to be installed on the farm was equipped with a 10-hp. motor and was rated as capable of supplying 550 g.p.m., or 2.2 acre-ft. per day. An allowance of 25 per cent was made to cover evaporation and seepage. A presentation of the data is made in Table X. This tabulation shows the number of acre-ft. applied during the months of the year, number of days and hours irrigating was done, number of kw-hr. consumed, the per cent of the total operation and power cost assignable to each crop, the proportion of the power cost assessed against each crop that is chargeable to irrigation, the cost per acre per year for irrigation, and the cost per acre-ft. of water.

The Electrified Farmhouse

The home of Snook O'Brien's farm also has been equipped with a large number of electrical devices and labor-savers including range, water heater, sewing machine, vacuum cleaner, flat iron, washing machine, toaster, percolator, fan and electric refrigeration machine. The costs of operating this equipment were figured on the general heating, cooking and combination service schedule which is as follows:

8c per kw-hr. for first 30 kw-hr. per month.
4c per kw-hr. for next 120 kw-hr. per month.
1.5c per kw-hr. for all over 150 kw-hr. per month.

Average installations show that the monthly consumption over a period of a year would be 470 kw-hr. This would give an average monthly bill for the domestic service of $12, or $144 per year. In Table IX it may be noted that, despite the fact that no return is allowed from the farmhouse, the charge for energy used for domestic purposes is included in the total power cost and is considered in figuring the percentage of power cost to gross earnings.

While the model farm of Snook O'Brien was designed as a means of increasing the use of electrical energy by agricultural consumers, it is in reality an argument for the diversification of crops in order that the farmer may secure the greatest benefit from the power which he purchases. The diversification of the crops will not only work toward that end, but also will protect the farmer in case of over-production of any one particular crop or of a failure of any product he might be raising. From the point of view of the central station, any action which may tend to increase the use of electricity and at the same time better the load factor is highly desirable.

Some Achievements and Responsibilities of "Customer-Ownership"

By E. J. Beckett
Assistant Treasurer, Pacific Gas and Electric Company

JUST eleven years ago the Pacific Gas and Electric Company mailed to each of the 260,000 customers then taking service from its lines a circular letter which marked the beginning of a new epoch in public-utility finance. It invited their participation in the purchase of an issue of its first preferred stock, in the following language:

> A number of our consumers have requested the privilege of joining in this subscription, thus obtaining an opportunity of sharing in the profits of the Company and possessing a voice in its management. Believing it to be to the advantage of the Company as well as its consumers that the stock should be distributed to as large an extent as possible among the representative citizens of California who are our consumers, the directors of the Company hereby extend an invitation to all consumers to purchase a portion of the above First Preferred Stock directly from the Company, at the minimum price authorized by the Railroad Commission. This stock may be paid for in full or in installments, in all respects upon the same terms and conditions heretofore offered to the Company's stockholders and employees.

It is, of course, recognized that efforts had been made here and there by industrial corporations and by public utilities to dispose of their stock direct to the public, but it is believed that the Pacific Gas and Electric Company was, without question, the first public utility in the United States to circularize its entire consumers' list and to conduct an organized campaign to sell stock direct to the local public through the efforts of its whole employee organization.

The success attendant upon this innovation in finance and the almost universal adoption by public-service companies throughout the country of what has since been christened the customer-ownership policy, now has become more or less a matter of history as far as the utility industry is concerned, and will not be enlarged upon here except to summarize very briefly some of the results achieved in their relation to the general trend of the distribution of corporate ownership. Suffice it to say, as indicating

the proportions to which this movement has attained nationally, that the electric light and power companies alone in the year 1924 sold by this means 2,478,165 shares of stock and added to their stockholders' lists the names of 294,467 individuals, while in the period from 1914 to 1924, inclusive, 7,525,572 shares were sold direct to 957,367 stockholders.

In the state of California, where the home-ownership idea first was placed in effect and where it probably has had its fullest development to date, a dozen of the largest gas and electric companies were owned at the close of 1924 by 140,637 stockholders, with aggregate holdings of $254,394,000. Of these partners in the utilities dispensing gas and electric service, at least 120,000 reside within the state's boundaries. Assuming each stockholder to represent an average family of four persons, it is a safe estimate that one-tenth of all the families in California have a direct financial interest in these utilities. A list of the companies and the amount of stock held is given herewith. **It is almost startling to learn that the first four companies in this list, at the time of beginning their respective customer-ownership campaigns, had an aggregate of less than 5,500 stockholders, with average holdings of 155 shares each; while their roster of partners now has grown to approximately 122,000, with average holdings of only 17½ shares.** Incidentally, it may be mentioned that the figures here given are exclusive of the common stock of certain of the companies, which are held by holding corporations.

California Power Companies and Customer-Owners

	No. of Stockholders	Par Value of Stock Held
Southern California Edison Co.	70,030	$ 76,097,172
Pacific Gas and Electric Co.	31,859	97,270,300
San Joaquin Light & Power Corp.	11,502	27,139,600
Los Angeles Gas and Electric Corp.	8,482	14,186,300
Great Western Power Co. of California	5,650	7,873,000
San Diego Consolidated Gas & Electric Co.	3,254	6,292,500
Western States Gas and Electric Co.	2,432	4,587,100
California Oregon Power Co.	2,300	8,097,800
Southern California Gas Co.	2,174	7,807,200
Coast Counties Gas & Electric Co.	1,431	3,247,700
Southern Counties Gas Co.	1,258	1,230,000
Coast Valleys Gas & Electric Co.	265	565,700
	140,637	$254,394,372

It is probably no exaggeration to say that the effects of this widespread dissemination of stock, as exemplified above in the distribution of the ownership of California utilities among local investors, have been not only nation-wide in their scope as regards the utility industry itself, but also have been felt in every other branch of industry, and have assisted materially in combating the communistic propaganda which seemed to be gaining such strength in the United States during the post-bellum period as to constitute a serious menace to national progress. Manufacturing and commercial enterprises, and even the railroads, have recognized the significance of the fundamental principles underlying the customer-ownership idea and have made vigorous and successful efforts to obtain a more widespread distribution of their securities than had hitherto been deemed possible.

The following tabulation, extracted from an article by H. T. Warshow, vice-president of the National Lead Company, shows the tremendous strides made toward popularizing corporate ownership in the United States during the past few years. It will be noticed that while, according to his carefully compiled estimates, the total number of stockholders in this country increased from 4,400,000 in 1900 to 7,500,000 in 1913, an addition of 3,100,000 in thirteen years, the next ten years showed a further increase of 6,900,000, bringing the number of partners in corporate enterprises up to 14,400,000. Concurrently, the average number of shares per stockholder decreased from 140.1 in 1900 to 49.7 in 1923. Putting the matter in another way, it may be stated that **in the period from 1913, which comes pretty close to being the opening of the customer-ownership era, to 1923, the total outstanding stock of all corporations in the United States increased less than 10 per cent while the number of stockholders in the country increased 92 per cent.**

Estimated Number of Stockholders, 1900-23

Year	Total Capital Stock of All Corporations in the U. S.	Average No. of $100 Par Value Shares per Stockholder	Estimated No. of Stockholders in the U. S.
1900	$61,831,955,370	140.1	4,400,000
1910	64,053,763,141	86.3	7,400,000
1913	65,038,309,611	87.0	7,500,000
1917	66,584,420,424	77.3	8,600,000
1920	69,205,967,666	57.3	12,000,000
1923	71,479,464,925	49.7	14,400,000

It cannot be assumed, of course, that the market for the distribution of many millions of dollars worth of stock annually to comparatively small investors was always present to the extent that now exists, and only was awaiting the action of the utility companies in initiating the practice of offering their securities direct to the public. Until comparatively recent years, the number of wage-earners who were financially able to invest in stocks was much more limited than at present. Mr. Warshow in this connection cites some interesting figures compiled from the U.S. income tax returns, which show that in the year 1917, 1,399,000 individuals filed returns showing incomes of from $1,000 to $5,000 each, with aggregate net income of $4,181,000,000, or 37.4 per cent of the total income reported by all individuals, while in 1922, 6,193,000 persons were in the $1,000-$5,000 class, with aggregate incomes of $13,522,000,000, or 63.4 per cent of all income reported. It is obvious that the increasing prosperity of what may be termed the wage-earning class to a large degree has influenced their ability to make an investment of any kind. **There can be no shadow of doubt, however, that the customer-ownership movement, as much as any one thing, with the possible exception of the Liberty Loan campaigns, has served to educate the general public in the principles of investment and has promoted the cause of national thrift and of industrial harmony.**

Broad-gauge public utility managers are beginning to recognize that their interest in the prospective purchaser of their securities does not end with merely selling him a stock certificate. Hundreds of thousands of people of moderate means annually are making their very first investment through the purchase of a share or two of stock in their local utili-

ties. A vast number of these investors are more or less inexperienced in financial matters and are unable to analyze accurately the merits of the securities which they purchase. They buy stock in the local electric company largely on the solicitation of the utility's employees of the advice of their neighbors or friends. It is, then, incumbent upon those who have the welfare of the public-utility industry at heart to see that the securities which they sell to their local customers are of an investment rather than a speculative character. More—they should make at least some effort to see that their stockholders are, as far as possible, informed of some of the rudimentary principles of investment to the extent at least of being able to distinguish between stable investments and securities which are highly speculative or worthless. It is an unfortunate fact that thousands of people annually, having once formed the habit of purchasing stocks, become the prey of unscrupulous stock salesmen engaged in selling the securities of all kinds of wild promotions which yield to the salesman a handsome commission, but which mean to the unfortunate purchaser too frequently not only the loss of interest upon his money, but also the loss of the principal itself. Salesmen of this type are particularly active in endeavoring to trade investors out of public-utility securities, which may be readily marketed, substituting worthless issues giving a glowing promise of large profits. An incident, rather exaggerated, possibly, but strikingly emphasizing the misery which may result from this practice, recently came to the writer's attention in the form of a clipping from the San Jose (Calif.) Herald, which is reproduced below:

Stock Transaction Is Suicide Cause

Thought to have been brooding over a stock transaction which had caused an alleged loss of about $2,000, Pat Ryan, aged about 65 years, yesterday took his own life by hanging himself from a transom of his cabin home at 831 Willis Avenue.

Detectives John Guerin and Thos. Short answered the call of Mose Vandermulla, a friend, who found the body, and in turn called Coroner Amos O. Williams, who took charge of the body and will conduct an investigation.

The officers found a note which read: "Please bury me decently. The key is to a safe deposit box at the Garden City Bank. Good Bye, Pat Ryan."

According to Vandermulla, who resides at 731 Martin Avenue, he has known Ryan for a long time and says he leaves a wife and two sons at Sisson, Calif. On December 23, 1924, according to Vandermulla, two men induced Ryan to transfer P. G. & E. stock of the value of $2,000 for stock in another company which Ryan told Vandermulla afterward had proved to be about worthless. Since this transaction Ryan has been brooding over his loss, according to his friend. Vandermulla was with Ryan until a late hour Saturday evening.

Educational work by the utilities through the medium of house organs or bulletins mailed to stockholders can be of material service in placing the inexperienced investor on his guard against unthinkingly exchanging his utility stock for the "securities" (save the mark of unstable, fly-by-night companies at the solicitation of an unknown salesman.

Every effort also should be made to see that stockholders' lists are kept confidential. There are a number of concerns in the country existing and making large profits solely through the sale of these so-called "sucker lists" to promoters and stock salesmen. Hundreds of millions of dollars worth of absolutely worthless securities are sold to the public every year in the United States, to a very large extent to the prospects secured through the use of these lists. In this connection, it is interesting to note that a definite effort is being made in some quarters to stop the compilation and sale of these lists for unethical purposes, as witness the following item in the Wall Street Journal of May 8, 1925:

Ontario Stops "Sucker" Lists

Ontario has passed an order in council prohibiting access to archives of shareholders filed with provincial secretary to all except those having minister's consent. Action has been taken to prevent compilation of 'sucker lists' by stock-selling organizations.

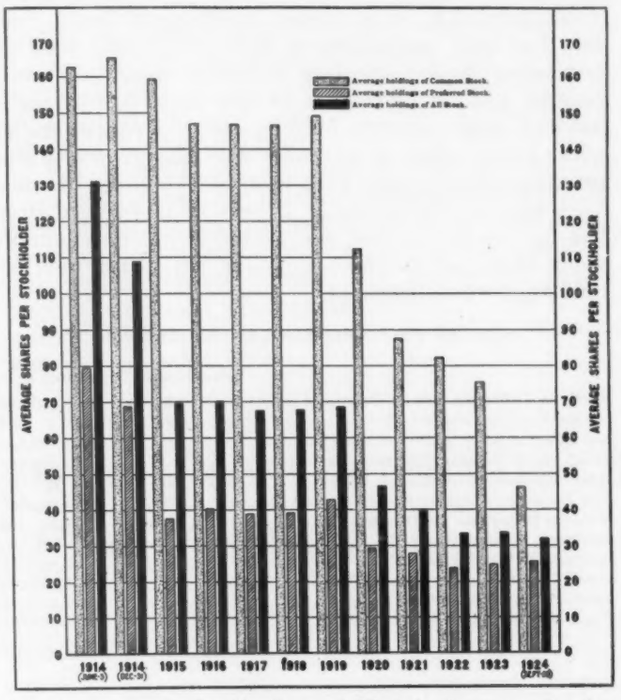


Chart prepared by Pacific Gas and Electric Company showing decreasing average holdings of stock since initiation of customer-ownership plan

Strong efforts also are being made in this country through banking organizations, state corporation commissions, vigilance committees of chambers of commerce and similar bodies, to put an end to the promiscuous peddling of worthless securities, and the public utilities should lend their best efforts to furthering this movement. A great deal of thought and very wide publicity has been given to the advantages of customer-ownership and to the methods by which securities may be sold to the public. The responsibilities of the public-service companies in maintaining the high standard of investments which they offer for sale, and in protecting investors against fraudulent promoters only now are beginning to be realized, and they merit the best attention of the industry.

NEWS OF THE INDUSTRY

Edison Company to Build Third 220-kv. Big Creek Line

Construction of 225 miles of 220-kv. transmission line between the Big Creek-San Joaquin River plants and the Eagle Rock substation of the Southern California Edison Company will be accomplished during the next three years, according to the announced plans of the company. This line, to be known as the Vincent line, will be the third transmission unit of the Big Creek-Los Angeles transmission system. The line and the necessary substation and switching facilities will cost $11,000,000. Additional hydroelectric power to be developed and the present fully loaded condition of the two existing 220-kv. lines are the major reasons for the construction of the new line.

The southern half of the line will follow a right-of-way entirely different from that of the existing lines. This, of course, means that much preliminary work in the nature of road-building and other general preparatory work must be done before construction work on the line itself is started. According to the present plans, road construction will start about Sept. 1. Actual construction work upon the line itself is scheduled to start Jan. 1, 1926, and will take about two years to complete.

Structurally the new line will be similar to the present lines. Due to the fact that much of the line will traverse mountainous country where long spans are possible, the average number of towers per mile as planned will be but 4.2 for the entire length of the line. The conductor to be used has not been announced officially.

Delivery of additional power to the extent of 150,000 kw. will be made possible by the new line. This will bring the total power which may be transmitted from the plants on the Big Creek-San Joaquin project of the Edison company, over the three lines, to 425,000 kw.

Colorado Springs Utility to Be Sold at Auction June 22

Following the presentation of the decree of sale by George S. Munson, counsel for the bondholders' protective committees, and J. L. Bennett, counsel for the co-receivers, Ivor O. Wingren and J. Frank Dostal, the Colorado Springs Light, Heat & Power Company was ordered disposed of at public auction in that city June 22. Judge J. Foster Symes of the federal district court also appointed Mr. Wingren special master to sell the utility. It is expected that the sale and its confirmation by the court will be accomplished in time for the bondholders to turn over the company's electric holdings to the city by July 1. On that date the city plans to commence municipal operation of the electrical distribution system.

The agreement between the city and the bondholders' committees covered the purchase of the company's electrical distribution system within the corporate limits for $600,000 in general obligation bonds (Journal of Electricity, Aug. 15, 1924, p. 142, and Nov. 15, p. 380) and the outside distribution system for $250,000 in income bonds. The city will operate the company's steam plant at Papeton until the municipal steam plant is ready, paying the bondholders for the use of the plant at the rate of 4½ per cent on $600,000.

Irregularities Claimed in Gorge Creek Tunnel Contract

In answer to a suit brought by R. M. Grant & Company, bond house, in the U. S. District Court at San Francisco, to recover $177,425 from R. C. Storrie & Company, principal contractor on the Skagit River development of the city of Seattle, the contracting firm has filed counter charges alleging certain irregularities in connection with the awarding of the Gorge Creek tunnel contract. The bond house seeks to recover the sum of money mentioned claimed to have been advanced to the contractor during the course of construction of the tunnel.

The Storrie company in its denial and countercharge claims that three bond houses doing business in Seattle virtually compelled it to enter into a conspiracy to obtain more than $2,000,000 of utility bonds of the city of Seattle below par, contrary to law and in fraud against the city. It is charged that the three bond houses conspired to obtain the municipal utility bonds at unlawful discount by inducing the contractors to raise their bids sufficiently to absorb the discount, and by promising the contractors certain concessions and rebates. The countercharges also involve C. B. Fitzgerald, former president of the city council, C. F. Uhden, chief engineer for the city on the Skagit project, and have been denied in toto by all firms and persons involved.

In the meantime state examiners have been going over the Skagit books, checking every item of construction, in which the city spent about thirteen million dollars. The Skagit plant was built with the proceeds of ten bond issues amounting to $11,000,000. If it develops that the city has been defrauded, action will be taken by the city council.

Alan C. Van Fleet is attorney for the Grant company and John L. McNab for the Storrie company.

Electrification of Oil Fields Contemplated by Union Oil Company.—The Union Oil Company is considerinig the electrification of its oil fields in the vicinity of Fort Collins, Colo. Should the plan go through, the fields will be served by the Public Service Company of Colorado.

Largest Steel Mill in West to Electrify Rolling Mills

One of the most radical change-overs from steam to electric drive in the history of the steel industry is to be made by the Colorado Fuel & Iron Company at its Minnequa Works, Pueblo, Colo. This plant, the largest steel mill in the West, recently completed arrangements for the adoption of electric power, generated on the premises, for use in its rolling mills.

Complete electrical equipment will be furnished by the General Electric Company. Two 10,000-kw. turbine generators will be the prime movers and will furnish alternating current to the main power lines at 6,600 volts. Other power-house equipment will consist of one 150-kw., turbine-driven exciter and one motor-driven exciter unit. Two 1,000-kw. synchronous motor generators will furnish direct current for operating power house auxiliaries and will tie in with other direct-current mill power circuits. Two 200-kw. dual generators, driven either by steam turbines or by induction motors, will be used to start the station auxiliaries in the event of failure of power from other sources. Three single-phase reactors will limit the short-circuit currents on the auxiliary alternating current bus. A complete switchboard also will be installed in the power house.

Complete electrical equipment will be furnished for driving a rod mill, a 14-in. merchant mill, and a rail mill. Motors with an aggregate capacity of 9,500 hp. will be installed in the rod mill. Two motors will be installed in each of the merchant mills, the 10-in. mill being driven by d.c. motors having a combined capacity of 1,800 hp., while the two d.c. motors in the 14-in. mill will be rated at a total of 2,250 hp. Three a.c. motors witih a combined capacity of 6,200 hp. will drive the rail mill. Direct current for the motors in the two merchant mills will be secured through the use of a 1,680-kva. transformer and a 1,600-kw. synchronous converter located in each mill. Necessary switchboard equipment will be installed in each mill.

A.I.E.E. Elects Officers.—At its annual meeting held in New York on May 15 the American Institute of Electrical Engineers elected the following officers: president—Dr. Michael I. Pupin, professor at Columbia University and well known scientist; vice-presidents—A. G. Pierce, Cleveland; W. E. Mitchell, Birmingham; H. S. Sands, Denver (re-elected); P. M. Downing, San Francisco; W. P. Dobson, Toronto, Canada; managers—M. M. Fowler, Chicago; E. C. Stone, Pittsburgh; H. A. Kidder, New York; treasurer—G. A. Hamilton, Elizabeth, N. J. (re-elected).

Pit River No. 3 to Be Ready for Service Early in July

Construction work on the Pit No. 3 project of the Pacific Gas and Electric Company is progressing smoothly and entirely according to schedule. The diversion dam (and bridge, combined) will be completed in about two weeks at the present rate of progress and will be opened for traffic about three weeks later, according to plans. The tunnel is about 95 per cent complete and is expected to be ready for service shortly. Concrete has been going into the surge chamber for the last four weeks. Nearly 3,500 cu. yd. of material will go into this structure. About two weeks will be required to finish pouring the surge chamber. Penstocks have been erected completely from the power house to the manifold. This manifold will take some additional time for completion due to the rather complicated design and the massive construction. Forms for this manifold are set. No difficulties have been encountered in the pouring operations so far.

Concrete pouring on the roof of the power house building was completed May 25. This was the last of the important jobs of its nature on the project. The 220-kv. bus structure is 100 per cent complete. All oil circuit breakers are in place and ready for service with the exception of a few minor finishing touches. Two of the three banks of transformers are in place and ready for service, and the third will be ready shortly. These banks were dried out, with the transformer cores in the tanks, by means of hot air. A drying unit was made up of a grid heater and a 12-in., direct-connected, motor-operated blower. The whole device was rigged up on the job from equipment available. A core temperature of 75 deg. C was maintained. Each bank was dried out in about a month's time under extremely unfavorable weather conditions.

Power-house interior, switch house, switches and switchboard are about 95 per cent complete and progressing according to pre-arranged schedule. No. 3 generating unit is complete. The armature was expanded, prior to fitting it on the shaft, by means of an electrically heated oven built on the job. Temperatures in different parts of the armature were checked by means of exploring coils installed at different points over the casting. In this way it was possible so to regulate temperatures that undue internal stresses in the casting were avoided. Similar methods served the other units. About 48 hours' time was necessary to accomplish sufficient expansion to permit assembly on the shaft. The second generating unit is about 95 per cent complete and unit No. 1 is about 75 per cent complete. Excavations for the tail race have been finished. Connection to the station bus at one end and to the Pit-Vaca 220-kv. line at the other end is all that remains to put the transmission line into operating condition.

All through this job the different divisions of activities have been so arranged that the maximum amount of work might be carried on with a minimum crew. But slight fluctuations have been noted in the number of men on the job since it was begun.

Construction work on the bus structure was carried on at the same time as that on the structural frame of the power-house building. All excavations for the power house, tail race, penstocks tunnels and lower penstock anchors were made with one full-electric and one steam shovel. Concrete for the power house, bus structure foundations, high-tension switch foundations, penstock tunnels and lower penstock anchors was placed by means of one central, gravity, concrete-placing plant. These features all tended toward speedy and at the same time efficient and economical construction. At the present time there are about 1,350 men engaged in bringing the job to completion.

Utah Towns Consider Whiteway Lighting Systems.—The Lions Club of Payson, Utah, is sponsoring the installation of a whiteway lighting system in the business district of that town. A committee consisting of Lee R. Taylor, Dr. L. D. Pfouts and Reid Persson has been appointed to take the matter up with the city council. The town of Parowan, Utah, also is considering the installation of a whiteway lighting system in the business district. The town of Price, Utah, is publishing notice of intention to construct a whiteway lighting system in the business district.

Dealers Display World's Largest Reproductions of Iron

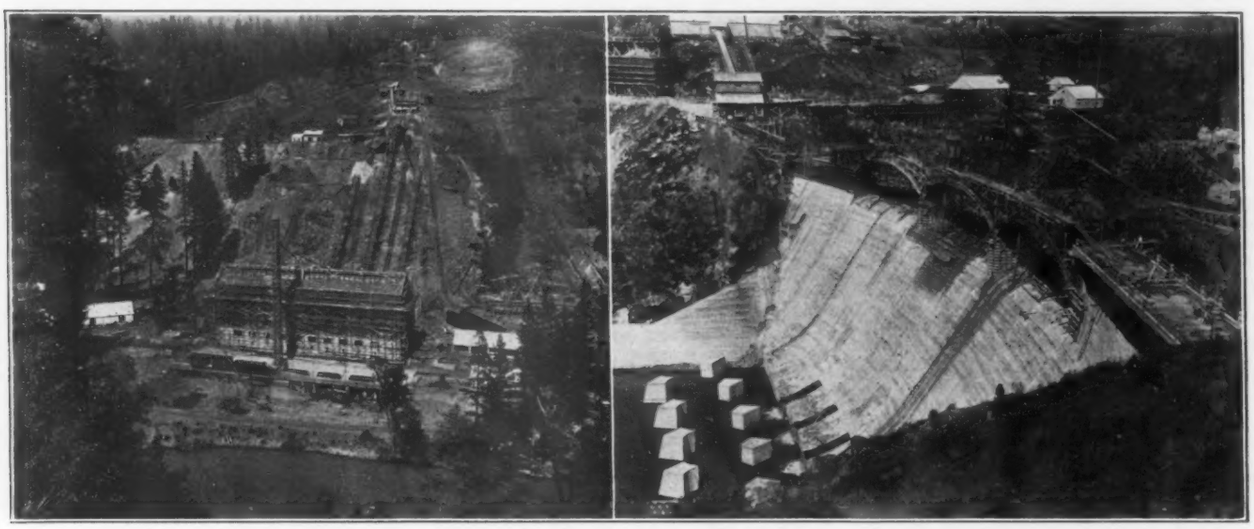
Twenty of the largest irons ever built, exact duplicates of the Hotpoint domestic electric iron, have been built recently by the Edison Electric Appliance Company, Inc., at its Ontario, Calif., works. These irons are being displayed at the present time throughout the United States in Hotpoint dealers' windows. Usually when the irons are being displayed contests are held to determine

One of the world's largest irons made at the Ontario works of the Edison Electric Appliance Company, Inc.

the weight of the mammoth model.

The irons are 20½ in. high, 32 in. long at the base. Each iron is fitted with a black ebonized handle, a dark red plug bar, with a thumb-rest of the same color. All of the metal work on the irons is finished in nickel plate, to correspond to the regular product of the company.

Fourth Big Creek No. 1 Unit Is Shipped.—The 25,000-kva., water-wheel generator which will comprise the fourth unit at Big Creek No. 1 power house of the Southern California Edison Company recently was completed and shipped from the Westinghouse factory at East Pittsburgh. This unit is capable of generating 28,000 kva., at 11 kv. and 300 r.p.m. An output of 31,000 kva. at 12.5 kv. may be developed at a speed of 360 r.p.m.



Recent views of the Pit No. 3 project of the Pacific Gas and Electric Company. At the left is shown the power house as it appeared May 18. The diversion dam and roadway bridge is shown at the right as it appeared May 20

Grays Harbor Company Announces Rate Reductions

The Grays Harbor Railway & Light Company, Aberdeen, Wash., has announced a reduction of between 18 and 22 per cent in electric rates to become effective after July 1. The reduction was announced in a letter from E. N. Sanderson of New York, head of the Grays Harbor system, addressed to the Aberdeen city council. The letter also pointed out what Mr. Sanderson considered the pitfalls in the city's plans to develop electric energy on the Wynooche River and suggested that the present city administration abandon the power phase of the Wynooche project.

While the letter discusses only light and cooking rates in Aberdeen, it is understood that the cut will apply throughout the Grays Harbor system and will affect rates in both Hoquiam and Cosmopolis. Although Mr. Sanderson presented a strong plea for protection for his company in the power field in Aberdeen, the cut in prices is in no way conditioned upon any action by the city council, resident officials of the company state.

The reduction in light bills will be important to the average consumer, it is pointed out. Under the new rates, any amount of current up to 200 kw-hr. will be sold at 7 cents, as compared with 9 cents for the first 20 kw-hr., 8 cents for the next 80 kw-hr. and 7 cents for the next 100 kw-hr. under the old rates. A reduction of about 80 cents on the average bill for cooking and heating of $4.40 is expected under the new rate.

Mr. Sanderson declares that the proposed reduction will reduce the company's gross and net earnings by about $42,000, or a reduction of 3 per cent on its investment, leaving 3.4 per cent as the rate of return for the year. The new rates provide a monthly minimum charge of $1.00. The new rate for cooking and heating will be 3 cents per kw-hr.

It was pointed out by city officials that the present administration has no authority to bind the city as to its future power development, and could only express its appreciation of the company's interest in reducing rates.

Denver Men Graduated by Public Utility Speaking School

Fifty Denver public-utility men recently were "graduated" from the "College of Speaking" of the Rocky Mountain Committee on Public Utility Information. Graduation exercises were marked by a dinner given at a local hotel by the members of the committee.

The Rocky Mountain Committee has been conducting a class in public speaking for three years. The attendance in that time has varied from twenty-five to fifty members, one evening of each week. The membership is recruited from every branch of the electric light, telephone, gas and street railway business, also from the ranks of jobbers, dealers and manufacturers. Included among those who regularly attend are managers and department heads as well as men of lower rank. H. H. Argabrite of the Western Electric Company, who has had wide experience in the field of public speaking, is instructor and critic.

Many of those who have been graduated from the information committee's "College of Speaking" took an active part in the franchise campaigns conducted by two of the major Denver utilities, the Public Service Company of Colorado and the Denver Tramway Company. Others regularly make public talks before the various civic, service and luncheon organizations. Others appear regularly before classes in the universities of Colorado and the high schools of Denver.

The committee's college not only has served to perfect the large number of utility men in the art of public speaking, but also it has operated to form a closer bond of friendship and cooperation among the utilities of Denver. The college will be re-opened early next fall.

Puget Sound Company Celebrates Silver Anniversary

The striking growth and development of the central-station business in the Northwest was brought out recently by the Puget Sound Power & Light Company, Seattle, on the occasion of the celebration of its "Silver Anniversary." Grasping the opportunity to tell a romantic and picturesque story of the part played by the company in the upbuilding of the prosperous Puget Sound territory, advertisements and historical sketches were prepared for the newspapers telling of twenty-five years of successful operation under one management.

This publicity material brought out the fact that the Puget Sound Power & Light Company was organized in 1899 to consolidate eight street railroads and three small lighting companies in Seattle, many of which were in the hands of receivers and none of which were able to finance their operations nor meet the demands of the growing city. At that time several small steam plants rendered precarious service each to its own small coterie of customers, mainly for illuminating service; and the chaotic condition of competition among the street railway companies made transportation across the city difficult and expensive.

Contrasting conditions then and now, the advertisements show that by the end of the year the company will operate eleven hydroelectric and eight steam plants with a combined capacity of 248,000 hp., serving over 100,000 customers in 300 communities, by means of 1,185 miles of transmission lines and 4,090 miles of distribution lines. Transportation facilities of the company now include two interurban lines, six street railway systems, and five stage lines, operating over 13,000,000 car miles and carrying 43,271,000 passengers in 1924.

The Age of Electricity
Our Silver Anniversary
THE Puget Sound Power & Light Company is, this year, celebrating its Silver Anniversary—twenty-five years of furnishing light, power and transportation under the same continuous management. Remarkable as has been the growth of this district, the company has kept pace with its tremendous progress and no community which it serves has ever lost an industry through lack of adequate, cheap power.
To accomplish this, the company now has in operation eleven hydro-electric and eight steam generating plants which, by the close of the present year, will bring its power resources to 248,000 horsepower.
In extending its service to all parts of this territory, the company has built over 5,200 miles of transmission and distribution lines until it now serves in excess of 300 communities and more than 102,000 customers. Over 8,000 citizens of Washington have invested their savings with this company until they now own over $9,000,000 of its securities—customer ownership, which is true public ownership.
It is one of the strong, established business enterprises of this community, distributing over $10,000,000 annually here at home in its pay-roll and purchase of materials and contributing as its share of the tax burden, in excess of $1,000,000 a year.
POWER PUGET SOUND LIGHT
As the years go on, this company, in partnership with the people of this state pledges itself:
1. To extend its service wherever justified.
2. To continue the development of electric energy, keeping well ahead of requirements, so that an ample supply of power will always be available to attract new industries and new payrolls throughout the entire district.
3. To take advantage of every successful invention for reducing costs or increasing efficiency so that the rates to consumers may be as low as possible.
4. To continue offering its securities locally so that every customer may become a part owner in this organization.
PUGET SOUND POWER & LIGHT COMPANY

One of the advertisements used by the Puget Sound Power & Light Company to celebrate its "Silver Anniversary"

Appeal Filed by Edison Company in Water Rights Suit

Appeal was filed May 28 with the California state supreme court by the Southern California Edison Company, Los Angeles, to set aside the decision rendered about three months ago in the suit brought against the company by the heirs of the Herminghaus estate (Journal of Electricity, Sept. 15, 1924, p. 220). The judgment barred the company from further impounding water on the head waters of the San Joaquin River for use in conjunction with its Big Creek development project. Water might be diverted into Huntington Lake and thence run through the chain of power houses on Big Creek and the San Joaquin River, under the terms of the decree, but no storage of water would be allowed other than that coming from the runoff in the Huntington Lake basin (Journal of Electricity, March 1, 1925, p. 185.)

The plaintiffs contended that their property, consisting of 17,000 acres of land lying along 22 miles of frontage on the San Joaquin River, would be damaged and their riparian rights interfered with if the company were allowed to impound the river waters and thus prevent the spring flooding of the lands of the estate that provided natural irrigation, deposited silt and replenished the ground water supply.

In the present status of the matter, the decision of the superior court not only prevents the storage in Huntington Lake of San Joaquin River head waters brought through the Florence Lake tunnel, and all additional storage in reservoirs planned at Florence Lake, Vermillion Valley, Shaver Lake and Blaney Meadows on the east side development of the San Joaquin project, but also prevents storage on the entire west side development of the same division of the project. According to the plans of the company, this would comprise eight storage reservoirs and fourteen power houses on the Middle Fork of the San Joaquin River to be constructed upon the completion of the east side development.

S.E.D. Seeks Pictures of Home Application of Electricity

The Society for Electrical Development, Inc., is directing attention to the Spring 1925 Better Homes Supplement recently issued by the American Homes Bureau, Chicago. Nineteen per cent of the space is devoted to electrical service in the home, the material having been supplied by the society. Considerable stress is laid upon lighting, so that the edition constitutes a follow-through on the Home Lighting Contest, in addition to stimulating the buying of all kinds of electrical appliances.

The supplement is syndicated and publication rights already have been sold to newspapers in about 100 cities. Similar supplements are issued each spring and fall. Material used in the spring issue constitutes the fourth contribution of the Society for Electrical Development. It is planning to supply copy for the forthcoming fall supplement, but it needs photographs which show the application of and sell the idea of electrical service in the home. This type of photograph, rather than that exploiting a particular make of product, will be utilized in making line drawings. The society suggests that photographs of this nature be sent to the News Service Department, The Society for Electrical Development, Inc., 522 Fifth Avenue, New York.

Great Western Power's S. F. Division in New Offices

The San Francisco division of the Great Western Power Company recently moved from 347 Grant Avenue, where it had been situated for many years, to new quarters at 437 Sutter Street. The building, which was purchased by the company, has been remodeled completely. Rapid growth of the company's business in San Francisco necessitated larger offices, according to officials of the company, and improved service will be one of the results of the move.

One of the features of the new quarters is the modern electric kitchen in charge of a demonstrator, who will give information on the various uses of electricity in the home. The company also has on display a complete line of electric ranges, air heaters and water heaters.

Pacific Coast Number Issued by Western Electric Dealer

The May issue of The Western Electric Dealer, which is published monthly in the interest of its dealers by the Western Electric Company, Inc., is a special Pacific Coast number. From its attractive cover, which uses each letter of the magazine's name to acclaim in illustrated form many of the outstanding attributes of that region of the country, to the back cover, which heralds the N.E.L.A. convention with the heading, "New Light from the Golden Gate," the issue is devoted to the states of Washington, Oregon and California.

The leading article, by J. U. Berry, advertising manager, and C. F. Wolf, illuminating engineer, of the Valley Electrical Supply Company, Fresno, deals with the merchandising methods of that concern and also discusses the solving of the illumination problem through the use of proper fixtures. There are, in addition, numerous shorter articles about various dealers in different parts of the Pacific Coast territory. Many excellent photographs portray window displays, store interiors and exteriors, electric signs and kindred subjects. Two pages are given over to photographs of the radio broadcasting station KFI of Earle C. Anthony, Inc., Los Angeles. All in all, the May Western Electric Dealer is a particularly interesting and attractive issue.

House Organ to Be Published by Denver Central Station

The Public Service Company of Colorado, for the first time since its consolidation of subsidiary companies, is publishing an employees' magazine, "The Triad," the first issue of which has just been distributed.

In keeping with the practice of other Doherty companies, each of the independent companies is publishing a magazine, monthly or oftener, devoted to the interests of the public and stockholders as well as the employees. The magazine is published twice a month under the direction of F. R. Jamison as editor, with E. K. Hartzell and R. A. Turner as associate editors, the latter devoting all of his time to the publication.

Messages for Backs of Monthly Bills Are Prepared

Designed to present to central-station customers an idea of the service that is being rendered in return for the monthly bills, the Western Electric Company, Inc., has prepared a series of messages entitled, "What's Back of Your Bill?" The company has prepared twelve of these messages which can be printed upon the backs of any central-station company's monthly bills, and to assist company managers in their use has bound the series in pamphlet form.

What's back of your bill*
It may cost you a few cents to see this eclipse
Sunset is nothing more than the earth getting between the sun and us. As everybody knows, this eclipse starts earlier on winter nights than in summer.
More hours of darkness — that's why your electric light bill is usually bigger in the fall and winter months.
You may pay more, but you certainly get more—more of this cheerful, safe and efficient light. And that holds for the darkest, stormiest days of winter; you can count on our men to keep the lines open and the generators humming.
That's our idea of service.
*The short days of fall and winter
No. 9 of a series explaining what it is you are really paying for in your electric light and power bill.

One of the messages prepared by the Western Electric Company for use on the backs of customers' monthly electrical bills

Each one of the pieces of copy is illustrated, the drawing tying in closely with the printed message. The Western Electric Company has offered to furnish the illustrations, free of charge to any central station desiring to use them. Complete information concerning the series may be secured from the company's head offices, 100 East 42nd Street, New York City.

City of Eugene, Ore., Files on Power Site.—Application has been received in the office of Rhea Luper, state engineer, Salem, Ore., for the appropriation of water from the McKenzie River for power development and municipal water supply by the city of Eugene. The application calls for 10,795 theoretical horsepower at the dam site in Lane County, and 17,454 theoretical horsepower at the end of the canal. The cost of the development is placed at $375,000 in the application.

Muscle Shoals Power May Not Be Sold During Test Period

Washington Correspondence

Apparently power at Muscle Shoals will be available so sporadically during the testing period, which will extend from August to late next spring, that no formal contract will be entered into for such power as may be available for sale.

The electric contractors in charge of the installation which will convey the power away from the dam have advised the chief of engineers that the testing of machinery should be conducted under load and not with water rheostats as had been suggested. They also point out that a temporary installation will advance greatly the tuning up of the plant and can be handled in such a way as to create no additional hazard. In this way it will be possible, it is believed, to test out the four generators which are being installed first.

It may require until Dec. 1, or even the first of the year, General Taylor says, to complete the testing of the four generators. It is expected that the switchboard then will be ready for test, after which the four other generators are expected to be ready for testing.

General Taylor believes it would interfere unduly with the completion of the project to be under any commitments or even under implied obligations to give advance notice as to the cutting off of power. He favors an arrangement whereby the tests can be made under the actual load that would be furnished through connection with the lines of the Alabama Power Company. That plan, however, will reduce the return to the government for the sale of the temporary power. With no assurance as to continuity of power it would be necessary for the Southeastern power companies to keep their steam auxiliaries ready for immediate use. Under such conditions these companies probably would be willing to pay for this power nothing more than such saving of coal as would result.

Illuminate San Diego Pool with Underwater Floodlights

Notable in many respects for its electrical installations, perhaps the most unique feature from an electrical standpoint, in the million-dollar amusement center at Mission Beach, San Diego, is the installation of underwater illumination in the giant bathing pool constructed there and formally opened May 29.

A set of seven large floodlights is embedded in the walls of the pool at its greatest depth of 9 ft. The lighting units are enclosed in a large pyramid-shaped casting, having a vent at the top leading through a goose neck to a manhole back of the pool walls. The lamp unit is protected from the water by a 7/16-in. Pyrex glass, 18¾-in. in diameter. Difficulties as to the cracking of heavy plate glass had been numerous until the adoption of the heat-resisting glass. Water on one side of the glass at low temperature and the heat generated by the 500-c.p. lamp in the unit on the other side of the glass, together with moisture, condensation, and other mechanical factors, have provided considerable basis for experimentation on this installation.

Other electrical features of the amusement center aside from the Luna Park now under construction, are numerous. The big pool and the children's pool are being lighted by a large number of overhead lights, focused by large enameled reflectors. In the corridors and balconies beautifully designed and ornamented lighting fixtures soften and harmonize the illumination with the artistically decorated building itself.

Outside, big floodlights illuminate the building, and two giant searchlights and a number of floodlights make the long beach a blaze of light at night, permitting night surf bathing.

Electric conveniences abound in the general operation of the bath house, from its elevators to carry wet suits to an electric laundry, to its extensive telephone and fire alarm systems, its fire protection apparatus and its controls.

An extensive street and esplanade lighting system has been installed, utilizing the Westinghouse equipment of standard street lighting. An elaborate system of light controls and dimmers has been installed in the dance pavilion. Microphone connections with long-distance lines are contemplated to broadcast the dance music through a Los Angeles radio station.

Power Generation Suggested in California Water Resources Report.—In a report on the water resources of California filed with the 1925 legislature, it is stated that with 400-ft. dams on the upper Sacramento, the Feather and Yuba Rivers, and a 300-ft. dam on the American River, 3,000,000,000 kw-hr. of electrical energy could be generated annually prior to the full use of these reservoirs for domestic, irrigation or industrial use. In the main the report deals with the importation of water for irrigation in certain sections of the interior valleys where the supply of ground water is nearing exhaustion.

New electric sign of the Public Service Company of Colorado at its Boulder, Colo., office. The sign proved an effective advertisement in a commercial lighting campaign being conducted by the new business department of the company. Following the installation two sales were made in Boulder

Reservations Now Being Made for Electragists' Annual Meeting

Plans are progressing rapidly for the 1925 annual convention of the Northern Division of the California Electragists to be held in Eureka Aug. 6-8. Hotel reservations must be made through the San Francisco office of the California Electragists, 522 Call Building, and it is suggested this be done at once. Those planning to attend are requested to give complete information when writing regarding the accommodations desired. The convention registration fee will be $5 per person as in the past.

A committee of six has been appointed by Victor Lemoge, president of the organization, to take complete charge of all details of the convention, and the committeemen promise a most interesting and valuable program. The program of entertainment is being prepared by the Eureka electragists, and they are sure to have something that will be interesting to every member of the family. The convention is open to anyone in the electrical industry, and from the preliminary reports a large number is planning to be present. More detailed information covering the convention plans will be sent to all electragists in the near future; they will also appear in the July 1 issue of the Journal of Electricity.

Colorado Investigation Bonds Voted by Los Angeles

Los Angeles voters at an election on June 2 approved the sale of $2,000,000 worth of bonds, the proceeds of which are to be used to make a complete and adequate survey of the possibilities of bringing water from the Colorado River to Los Angeles for domestic purposes. The final count stood 86,149 for, and 15,909 against, the bonds.

In urging the vote for this bond issue great stress was laid upon the imperative need of a plentiful supply of water for the city in its future growth. However, the advocates of municipal water and power in Los Angeles gave it their unqualified indorsement and it is looked upon as a forerunner of their attempt to enter actively into the power development of the Colorado River.

Third Annual Radio Exhibition in Los Angeles Sept. 5-12

Announcement has been made that the third annual National Radio Exhibition will be held at the Ambassador Auditorium, Ambassador Hotel grounds, Los Angeles, Sept. 5-12, inclusive.

This exhibition will be conducted by the Radio Trade Association of southern California, consisting of the Radio Dealers' Association, Radio Jobbers' Association and the Radio Manufacturers' Association. The program calls for daily spectacular entertainment and illustrated educational lectures where nationally known radio experts and authors will be featured.

A special preview of the Radio Exhibition for dealers and the trade only will be held the evening of Sept. 4. This will enable exhibitors to make contact with the trade when the general public is not invited.

Thousands of radio dealers and "fans" who are not able to attend will be reached through the broadcasting of programs.

Dealer Home Lighting Campaign Planned by Westinghouse

A home lighting campaign, planned to enable electrical dealers to take advantage of the interest aroused by the recent national better home lighting contest, has been prepared by the Westinghouse Lamp Company in cooperation with the merchandising section of the Westinghouse Electric & Manufacturing Company.

The material to be used in the campaign has been prepared with a view toward making it as far as possible an individual dealer campaign. The printed matter will be published in the name of the dealer, with very little reference to the Westinghouse company and will be written in the second person. It is believed that a much more personal appeal thus will be made than would be the case with ordinary circular letters and booklets.

This campaign material will consist of a personal letter on an attractively lithographed letterhead to be sent to each customer and prospect, together with a copy of "The House That Jack Rebuilt." This is a 20-page booklet describing the transformation of a home through the application of proper lighting. It is written in conversational style and is illustrated with full-page pictures in five colors showing proper lighting arrangement in different rooms. There are numerous small illustrations of lighting fixtures and appliances. The last two pages of the book written in the first person, are devoted to explaining that the local electrical dealer is especially fitted by his training and experience to arrange lighting fixtures not only to add to their efficiency but to furnish esthetic atmosphere and extending a cordial invitation to consult with him.

With this booklet is sent a return postcard imprinted with the dealer's name and address. To all prospects who send back the return postcard a second letter is sent, together with "The Vogue in Home Lighting," a 48-page booklet, fully illustrated with photographs and diagrams. This booklet is a textbook on modern home lighting and contains suggestions to home-owners as to how they may improve the illumination in their houses, with the help of the dealer.

Employees' Manual Contest Closed by Washington Utility

The employee's viewpoint of public relations work is clearly shown in an article prepared by F. J. Rotter, a draftsman in the engineering department, The Washington Water Power Company, Spokane. The article was awarded the first prize of $50 in a contest within the company for the best presentation of the subject to be used as the concluding chapter of the employees' manual distributed by the utility. The second prize of $25 was won by T. E. Holsey, division agent at Okanogan, Wash., while honorable mention was given to E. H. Collins, engineering department, H. P. Venables, commercial department, and J. G. Finley, service department.

The winning article, which is to be printed as Chapter 12 of the manual, is entitled "Building Good Will," and it summarizes some of the facts contained in the manual and touches the high spots in the preceding chapters. The following extract from it indicates its merit:

"More money is paid out for the labor of men and women than for anything else in the world. Labor, therefore, is the greatest of all commodities. The true worth of work is not a matter of either hours or the task. Rather, it is the quality of service rendered that sets the value. If the daily performance of every utility employee squares with these principles, if courtesy, honesty, loyalty and devotion are enlisted in the campaign for better and broader public relations, employees will make friends for their company and the suspicions of propaganda will be cast into discard by enlightened public opinion."

Japanese Utility Plans Extensive Power Development Project.—Permission to appropriate water from the Tenryu River for generation of electric energy has been granted the Tenryugawa Power Company of Japan. The company plans to develop five sites with an aggregate plant capacity of 100,500 hp., according to advices from Japan.

Manufacturer Prepares Displays for Central Stations

A portable window display, a sample of the "DeLuxe Window Service" being offered to central stations by Manning Bowman & Company, has been placed on exhibition in the Pacific Coast district offices of the company at 150 Post Street, San Francisco. The display presents one of the seven that have been prepared by the advertising department of the manufacturer.

The portable exhibit, in addition to presenting an attractive display of electric percolators, demonstrates the most modern practice in color-lighting for show windows. The service being offered by the company has been taken up by a number of Western central stations. A complete description of the service will be presented in the Better Merchandising section of the Journal of Electricity at an early date.

Irrigation Districts and Utility Join in Power Project

Under the cooperative agreement with the Oakdale and South San Joaquin Irrigation Districts, the Pacific Gas and Electric Company will build a 30,000-kw. hydroelectric plant to cost $1,500,000 on the Stanislaus River near Melones, Calif. On May 18 the two irrigation districts approved a bond issue of $2,200,000 for building a dam and reservoir. The power company will build the power plant. In return the Pacific Gas and Electric Company will pay for the water an amount aggregating $5,175,000 over a 40-year period, or approximately $125,000 a year, an amount sufficient to meet all interest and retirement payments on the bond issue of $2,200,000.

After the power company has made the payments stipulated it will bear half the expense of maintaining the storage facilities. A 210-ft. dam of 112,000 acre-ft. capacity is to be built across the Stanislaus River near the town of Melones in central California. The power house a mile down the river will connect with the dam by a tunnel, so built as to take the greatest possible advantage of the head available. The dam is to be built immediately, but the date for completion of the power plant has not been set.

Denver Has Third Electrical Home Exhibit

More than 10,000 people have visited the third electrical home in Denver since it was opened to the public May 24. Many favorable expressions are being received by the Electrical Cooperative League in connection with the exhibition, according to reports from Denver, because of the completeness of the home and the presence of many features not found in previous exhibitions of a similar nature in the Inter-mountain territory.

Portable window display of Manning Bowman & Company that is one of a series of seven offered to central stations

Meetings

Quarterly Meeting of Southern Electragists June 27

The first quarterly meeting of the California Electragists, southern division, will be held at the Hotel Maryland, San Diego, Saturday, June 27, 1925. The members of the southern section and their friends will leave Los Angeles harbor on the S.S. Ruth Alexander, Friday, June 26, at 6:30 p.m. A dinner dance, together with other entertainment, will be a feature of the evening.

The ladies will be entertained during the morning. A golf tournament is planned, as well as automobile trips to the Mission Hills, Ramona's Marriage Place, Point Loma, and the old Spanish lighthouse. At the same time the men will convene to discuss the question of electrical merchandising, under the chairmanship of O. N. Robertson of Santa Ana. At noon the party will adjourn to attend the first annual baseball game between the jobbers and manufacturers, and the electragists.

In the afternoon the ladies will be taken through Balboa Park to enjoy a recital on the outdoor organ, while the men will continue their session of the convention to discuss the outline of the electragists' program for the future and the Red Seal campaign. H. H. Harper of the Western Electric Company and F. M. Feiker of The Society for Electrical Development will be the principal speakers.

The San Diego electragists and their friends will entertain the guests at the evening banquet, and at 10 p.m. the party will re-embark on the Ruth Alexander for the return trip to Los Angeles. The entire expense for the trip will be $13 per person. Reservations may be made through C. J. Geisbush, Room 610 Cotton Exchange Building, Los Angeles.

California Electrical Bureau Organization Changed

After a prolonged and intimate discussion, the plan for reorganization of the California Electrical Bureau as submitted by the finance committee was adopted by the Advisory Board at a meeting held in Los Angeles May 29. This plan is far-reaching in its nature and provides that beginning June 1 the Bureau will maintain offices in San Francisco and Los Angeles, the former in charge of Victor W. Hartley as executive secretary, the latter in charge of W. F. Brainerd. G. M. Rankin will continue as field man, performing special duties in the San Joaquin Valley district with headquarters at Fresno.

An arrangement has been perfected between the Bureau and California Electragists by which through the establishment of a basis of cooperation Electragists will undertake the responsibility for handling the greater part of the field work for the Bureau in carrying out such sales-promotion plans as may be developed from time to time. The Electragists also will assist the Bureau in bringing about the organization of a merchandising section within the Bureau and the establishment of local branches of this section at such points within the state as may be advisable. It was pointed out during the discussions that this arrangement undoubtedly would be far-reaching in its effect upon the electrical industry in California, and offers for the first time a practical means of bringing about the most complete cooperation between all branches of the industry in increasing electrification in the state.

The recommendations of the Society for Electrical Development with respect to details concerning the operation of the Red Seal Plan were approved by the Advisory Board, thus settling the last matter of detail in these negotiations so that active work may be prosecuted in this effort as soon as the N.E.L.A. convention is over. Two subcommittees have been appointed by the Advisory Board for the purpose of exploiting the Red Seal idea within the industry. These committees consist of H. L. Harper, chairman; W. L. Frost and F. E. Elser in southern California, and W. S. Berry, chairman; C. E. Heise, and C. L. Chamblin in northern California.

The secretary reported with respect to the electric home program that three homes already had been completed showing a total attendance of 16,600, and nine other homes are under way to be completed and exhibited during the course of the year. On the June Bride Week campaign 150 sets of window-display material already are being displayed throughout the trade, while 5,000 posters and 292,000 direct-mail inserts were distributed by power companies, jobbers and electrical retailers. A window-lighting exhibit has been displayed before thirty-four meetings with a total attendance of 2,591, resulting in twenty-six immediate sales and sixty-six live prospects directly traceable to the interest displayed in this exhibit. At the recommendation of the Pacific Radio Trade Association the Bureau will include radio outlets in the Bureau's wiring plan when a new edition is issued.

COMING EVENTS

Pacific Coast Electrical Association—
Annual Meeting—San Francisco, Calif.
June 15, 1925

National Electric Light Association—
Annual Convention—San Francisco, Calif.
June 15-19, 1925

Utah Engineering Council Hears President of A.I.E.E.

Farley Osgood, president of the American Institute of Electrical Engineers, was the principal speaker at the annual banquet of the Engineering Council of Utah, held at the Hotel Utah in Salt Lake City on the evening of May 23. About two hundred guests were present.

Mr. Osgood stressed the fact that engineers should take a greater part in the political life of the country. He said that those of this profession, by reason of the training that they had received, were highly qualified to assist in directing the affairs of the municipalities, the states and the nation. That they do not occupy such positions, the speaker declared, is because of their own apathy. "There should be an engineer on every committee having to do with public problems, for a great majority of these problems are engineering problems," he declared.

G. M. Bacon, state engineer of Utah, and president of the Engineering Council of Utah, was also one of the speakers. Markham Cheever, chief engineer of the Utah Power & Light Company, was toastmaster.

Bronze Tablet Erected in Honor of Thomas A. Edison

In the presence of the entire Edison family, the governor of New Jersey, the mayors of a number of New Jersey and New York cities, the president of Princeton University, the chief executives of the larger companies in the electrical industry, and practically all the surviving early associates of the great electrical genius, Mrs. Thomas Alva Edison on May 16 unveiled a beautiful bronze commemorative tablet marking the spot in Menlo Park, N. J., where Edison began his experiments and where nearly all his inventions were conceived and perfected.

Bronze tablet erected by the Edison Pioneers in honor of Thomas A. Edison

The tablet, set in a huge natural boulder which rests on a base of concrete containing bricks from the foundation of Edison's first home in Menlo Park, is erected on the Lincoln Highway within a stone's throw of the site of the original Edison laboratories and workshops and of the present Edison home. It bears the following inscription:

On this site—1876-1882—Thomas Alva Edison began his work of service for the world to illumine the path of progress and lighten labor for mankind. This tablet is placed by the Edison Pioneers to attest the gratitude of the industries he did so much to create.

As a state monument, the tablet formally was given into the custody of Governor George S. Silzer of New Jersey by John W. Lieb, vice-president of The New York Edison Company and first electrician of the original power-generating station built by Mr. Edison in New York City in 1882. Mr. Lieb presided over the day's ceremonies.

Personals

J. E. Macdonald, secretary of the Joint Pole Committee of Los Angeles, recently was elected president of The Electric Club of that city. Since 1907, when the joint users of electric light, telephone and telegraph poles in Los Angeles formed the Joint Pole Committee, he has been secretary of that body. Mr. Macdonald was born in

J. E. MACDONALD

Canada and graduated from McGill University, Montreal, in 1897, receiving degrees in both electrical and mechanical engineering. Upon leaving college he became an apprentice draftsman at the Browne & Sharp Manufacturing Company's plant at Providence, R. I., and then entered the employ of the William Sellers Company of Philadelphia, where he was employed as a designer of electrical traveling cranes. He arrived in California in 1901. For the first three days he wheeled bricks, according to his own statement, after which he joined the Pacific Electric Railway as line superintendent, leaving that organization in 1907 to assume his present position. Mr. Macdonald organized the Los Angeles Section of the American Institute of Electrical Engineers in 1908, was secretary for three years, and then served a term as chairman. At the present time he is vice-president of the A.I.E.E.

D. J. Jackson, until recently sales manager of the Dudlo Manufacturing Company, Fort Wayne, Ind., has joined the organization of the Lombard J. Smith Company, the Dudlo company's representative in southern California and Arizona.

R. B. Childs, of the sales department of The Washington Water Power Company, Spokane, visited Seattle lately on company business.

T. P. Walker, manager of the El Paso Electric Railway Company, El Paso, recently returned from Houston where he attended the annual convention of the Southwestern Public Service Association.

Col. William Kelly, chief engineer of the Federal Power Commission, shortly will become director of engineering for the National Electric Light Association. **Maj. G. E. Edgerton,** assistant chief engineer, will succeed him.

R. E. Kinkead, former chief engineer of the welder division of the Lincoln Electric Company, Cleveland, has been transferred to the sales department as director of sales with headquarters in the Ellicott Square Building, Buffalo.

J. L. Beebe, formerly with the Western Electric Company, Salt Lake City, now is representing the Trumbull Electric Manufacturing Company. Mr. Beebe will cover the Pacific Northwest, with headquarters at 2511 East Cherry Street, Seattle.

R. F. Walter has been officially appointed chief engineer of the Bureau of Reclamation, succeeding F. E. Weymouth who resigned last fall. Mr. Walter has been acting chief engineer since that time.

H. F. Hartzell, vice-president and general manager, Maydwell & Hartzell, Inc., San Francisco and Los Angeles, recently left San Francisco on a trip to the East via Seattle and Spokane with the intention of visiting all of his company's factories and connections.

R. G. Chamberlain, district manager, The Hurley Machine Company, Seattle, visited Spokane recently on general sales matters.

M. A. DeLew, electrical engineer, Associated Oil Company, with headquarters in Los Angeles, was a recent San Francisco visitor.

Z. E. Merrill, assistant general manager, the Mountain States Power Company, Albany, Ore., visited Spokane recently on his return from an inspection trip of the properties at Casper, Wyo.

R. W. Turnbull, Pacific Coast sales manager, Edison Electric Appliance Company, Portland, recently spent several days in Spokane in order to cooperate with the sales department of The Washington Water Power Company in the campaign on Hotpoint electric ranges which the latter has been conducting. **R. W. Cordiner,** special representative of the Edison Electric Appliance Company, also spent some time in Spokane giving his assistance in the same campaign.

C. E. Lasher, Tacoma, Wash., has been transferred to Everett to assume charge of the Puget Sound Gas Company. He succeeds Jesse Bourus, who has accepted an executive position with the Mountain States Power Company, the parent organizaiton.

F. B. Schuyler, president of the Johnson Washer Company of Oakland, recently has returned from the Pacific Northwest and the Intermountain territory, where he visited the company's distributors and investigated business conditions.

Lewis A. Lewis, sales manager of The Washington Water Power Company, Spokane, accompanied by **R. B. Childs** of the commercial department, lately made an inspection trip of customers' properties and service facilities in the Coeur d'Alene mining dstrict of northern Idaho.

M. P. Maxwell, sales manager of R. Thomas & Sons Company, New York, visited Spokane recently in the course of a general sales trip to the Coast.

F. A. Short, Safety Electric Products Company; **J. H. Pengilly,** Brown & Pengilly; and **Rollin M. Smith,** Rollin M. Smith Engineering Company, all of Los Angeles, were among those who attended the recent public hearing in San Francisco an the tentative Electrical Safety Orders issued by the Industrial Accident Commission.

G. A. Muir, who has been connected with the Denver office of the Allis-Chalmers Manufacturing Company for the past five years and for ten years previous to that with the machinery department of the Mine & Smelter Supply Company, Denver, has been elected president and manager of The Advance Machinery & Supply Company of that city.

C. P. Shattuck, until recently technical editor of the Commercial Car Journal, has joined the staff of The Society for Electrical Development, New York City. He will be connected with the electric delivery truck department.

H. R. Knelson has been appointed sales engineer of the Everstick Anchor Company for the territory west of the Mississippi. He recently was connected with the construction department of the Illinois Bell Telephone Company.

W. A. Hillebrand, from 1919 district engineer, Pacific Coast division, The Ohio Brass Company, Mansfield, Ohio, has been transferred to Barberton, Ohio, where he will assume the position of electrical engineer for the Ohio Insulator Company, which is the clay department of the Ohio Brass Company. After graduating from Cornell University in 1905, Mr. Hillebrand spent a year at Stanford University as a graduate student, after which he spent a year in the Western Electric Company's organization both in San Francisco and Los Angeles. From 1907 to 1911 he was instructor and assistant professor of electrical engineering at Stanford

W. A. HILLEBRAND

University, and then for the succeeding three years held the post of professor of electrical engineering at Oregon Agricultural College. In 1914 he entered the distribution department of the Pacific Gas and Electric Company, San Francisco, remaining until 1918 when he joined the Federal Telegrah Company at Palo Alto. He left the Federal company to become associated with the Ohio Brass Company. Due to the interest now being taken in the East in high-tension transmission lines, the number of such lines has been increasing steadily and the progress being made rapidly is lessening the lead which California heretofore has maintained. On account of this active interest Mr. Hillebrand's knowledge and experience will be particularly valuable in his new position with the Ohio Insulator Company where his time will be devoted largely to factory and commercial problems. Mr. Hillebrand is a member of the American Institute of Electrical Engineers.

R. H. Ballard, vice-president and general manager, Southern California Edison Company, Los Angeles, recently left California for an extended trip through Europe.

H. W. Stitt, city electrician of Fresno, Calif., attended the public hearing on the proposed Electrical Safety Orders recently held in San Francisco.

E. M. McLean, former sales division manager of the Four Wheel Drive Auto Company, Clintonville, Wis., has been promoted to general sales manager of that company.

R. L. Hearn, assistant chief engineer of The Washington Water Power Company, Spokane, has tendered his resignation and left for Niagara Falls, Ontario, where he will enter into partnership with H. G. Acres, who has been engaged in consulting work in hydraulic engineering with especial attention to hydroelectric developments. Mr. Hearn spent several years with the Hydro-Electric Power Commission of Ontario, where he served under Mr. Acres, who was formerly chief engineer for the commission. During the Queenstown development on the Niagara River Mr. Hearn was chief draftsman, and during the last year of his connection with the commission he supervised the actual construction. In June, 1922, he entered the service of The Washington Water Power Company at Spokane as hydraulic engineer and soon afterwards was appointed assistant chief engineer. In that capacity he supervised the latter portion of the construction program in the Spokane Upper Falls development. Since then and under the direction of V. H. Greisser, chief engineer, Mr. Hearn has supervised the design and construction of the rolling sector gate installed at the Post Falls development, and all the preliminary surveys, exploration work and designs for the development at Kettle Falls, Wash., on the Columbia River, the construction of which has

R. L. HEARN

been deferred. He also supervised the installation of the fourth 23.500-hp. unit at Long Lake power station, and the installation of the second 2,150-hp. unit at Oroville power station. During his residence in Spokane he was active in committee work for the National Electric Light Association and the Northwest Electric Light and Power Association. During the past year he has been chairman of the hydraulic power committee of the latter body. He is a graduate of the University of Toronto, and a member of the University Club and the Spokane Transportation Club.

T. M. Simpson, until recently vice-president and general manager of the Majestic Appliance Company, San Francisco, has been appointed manager of the electric advertising department of the Great Western Power Company of California, with offices at 530 Bush Street, that city. Mr. Simpson is well known to the members of the electrical industry, having been identified with the business for many years, both in the East and on the Pacific Coast. From 1903 to 1907 he maintained engineering offices in New York and Philadelphia, designing and contracting for the installation of power plants. Subsequently he was identified with the Hallidie Machinery Company, Spokane, Wash.

C. W. Scholefield, Standard Oil Company, Bakersfield, Calif, was a recent visitor in San Francisco where he attended the public hearing on the tentative Electrical Safety Orders.

S. C. Haver, Jr., supervisor of employment, Southern California Edison Company, Los Angeles, will add to his other duties that of chairman of the company's accident prevention committee, succeeding the late J. A. Lighthipe. The other members of the committee are: **T. H. Dukelow, R. E. Cunningham** and **A. F. Blight.**

C. M. Clark, Philadelphia, chairman of the executive committee of the board of directors of the Portland Electric Power Company, Portland, spent a few days in Portland recently looking over the properties of the company and conferring with officials as to future activities.

P. A. Anderson, formerly industrial engineer of the Great Western Power Company, Oakland, has joined the staff of the Oakland Bank as manager of their new business department.

Henrik Moe, president of the Moe-Bridges Company, Milwaukee, recently toured the Pacific Coast cities, accompanied by **B. J. Wildman,** Pacific Coast manager of the concern.

E. C. Gribble, president, the Electrical Specialty Company, San Francisco, recently left for a six-weeks trip East. While there he will visit the various factories which the Electrical Specialty Company represents on the Pacific Coast.

C. A. Bloom, advertising manager, Appleton Electric Company, Chicago, was a recent visitor on the Pacific Coast, where he made a study of conditions regarding distribution problems.

H. B. May, formerly of the Los Angeles office of the General Electric Company, has been transferred to the San Diego office in the capacity of resident agent for that locality.

Hal E. Cowgill, former operator of the high-tension substation of the Southern Pacific Company at Forest Grove, Ore., is now distributor for the Commercial Truck Company, builders of electric trucks, with offices at 202 Oregon Building, Portland. **Claude Jones** succeeds Mr. Cowgill at Forest Grove.

H. F. Dicke, for the past eight years general manager of the Utah Light & Traction Company, Salt Lake City. recently became assistant to the president of the Lehigh Valley Transit Company, operating between Allentown, Pa., and South Bethlehem, vice-president of the East Penn Electric Company of Pottsville, Pa., and vice-president of the Williamsport Passenger Railway Company of Williamsport, Pa. Mr. Dicke's headquarters will be at Allentown. Mr. Dicke is a native of Fort Wayne, Ind. In 1899 he entered the accounting department of the Fort Wayne Traction Company, where he served for a period of five years, resigning to become general auditor of the Ohio & Indiana Construction Company. For seven years he had charge of operation of the northern division of the Ohio Electric Railway Company, and then resigned to go to Boise, Idaho, as general manager of the Boise Valley Traction Company. Five years later he became general manager

H. F. DICKE

of the Utah Light & Traction Company at Salt Lake City. Mr. Dicke will be succeeded by **E. A. West,** for the past nine years general superintendent and chief engineer of the Denver Tramway Company, with headquarters at Denver.

Obituary

B. S. Josselyn, at one time president of the Portland Railway, Light & Power Company, now the Portland Electric Power Company, Portland, Ore., died suddenly May 21, 1925, at the age of 67. His early career was devoted to railroad service, and during that period he was associated with the Kansas City, Osceola & Southern Railway, the Omaha & St. Louis, the Omaha & Kansas City & Eastern line, the Kentucky & Indiana Bridge & Railway Company, Louisville, Ky., the Hudson Valley Railway Company, Glens Falls, N. Y., and the Union Terminal Railway Company, Sioux City, Iowa, becoming vice-president of the latter in 1906. Following this, he was vice-president and general manager of the Maryland Telephone & Telegraph Company and of the Baltimore Electric Power Company. In 1907 he went to Portland as president of the Portland Railway, Light & Power Company, on the death of its former president, H. W. Good, and remained in that position until his resignation in 1913 to take up the occupation of Christian Science practitioner.

Dr. A. F. Graf, member of the medical staff of the Southern California Edison Company, Los Angeles, died suddenly at his home, May 4. Dr. Graf joined the Edison company in 1918 after a long service in the United States Navy.

TRADE NOTES

General Electric Company, Schenectady, N. Y., recently has issued bulletin No. 47495.1, which contains much descriptive and illustrated data concerning its types of oil circuit breakers.

Charles Cory & Son., Inc., Chicago, has opened an office at 22 West Quincy Street to serve its increasing clientele for signal, control, communicating and lighting equipment.

The Westinghouse Electric & Manufacturing Company was the recipient recently of orders for feeder voltage regulators totaling over half a million dollars. These orders are for regulators varying in capacity from 11.5 to 888 kva. and in voltage from 2,300 to 13,800. Among those purchasing this equipment are the Los Angeles Gas & Electric Corporation, the Commonwealth Edison Company of Chicago, the Cleveland Electric Illuminating Company, the Commonwealth Power Company of Jackson, Mich., and the Public Service Production Company of New Jersey. The larger units will be used on power circuits.

California Wire & Cable Company, with general offices at Orange, Calif., recently has opened San Francisco offices at 404 Chancery Building, where it will handle the business for northern California, Oregon and Washington, carrying a large stock of weatherproof wire in all sizes.

Wellington Electric Company, Wellington, Colo., has been established recently by Warner & Sons, as a result of the increasing business in the oil fields of northern Colorado. The firm recently was awarded a contract for the wiring of a large parochial school in Fort Collins, Colo.

Industrial Works, Bay City, Mich, recently has announced a new and greatly improved 10-ton crawling tractor crane, known as its type DC. It is claimed that while its appearance is very similar to former types of tractor cranes its design embodies a host of new engineering features, such as split gears for propelling increased speeds, double-clutch mechanism, unusually long tractor belts and independent functions, which it is claimed make that machine the simplest and most economical to operate.

Sundh Electric Company, Inc., Newark, N. J., recently has issued a new bulletin featuring its automatic a.c. starters. The bulletin is illustrated with drawings and diagrams and describes the device in detail and gives price list.

Service Electric Company, Brigham City, Utah, recently has been established by S. Martin Rasmussen and D. L. Peterson. The firm will carry a complete stock of electrical fixtures and appliances and also will engage in house wiring and electrical repair work.

Pacific Electric Clock Company, San Francisco, now is constructing a $30,000 factory at Ninth and Parker Streets, West Berkeley, where it will specialize in the manufacture of school clock systems. J. J. Estabrook heads the concern as president.

The Lincoln Electric Company, Cleveland, Ohio, recently has perfected an automatic welder for use in the manufacture of storage tanks, which it is claimed cuts production costs in half. It is built for such jobs as arc welding of locomotive frames, cross-head guides, welding on truck sides, main driving wheels, journal boxes, brake levers and coupler shanks. The machine is provided with waterproof covers; a push-button starter, tool box handy but out of the way, spring-controlled handle, convenient cable hooks and light total weight are some of the other features.

Century Electric Company, St. Louis, has issued recently a leaflet describing its Century wool yarn system of lubrication for small motors. The booklet is illustrated with photographs and describes in detail the advantages of this new system.

Automatic Electric Heater Company, Warren, Pa., recently has placed on the market a new electric pressure regulator which is designed especially for use with domestic coal or oil-burning furnaces.

Circle F Manufacturing Company, Trenton, N. J., has acquired recently the business of Machen Electric Manufacturing Company of Philadelphia, moving the latter's plant to Trenton. Through this combination it will add a line of flush switches of both the push-button and toggle type, thus giving the company a complete line of electrical wiring supplies.

Locke Insulator Corporation, Baltimore, has announced a new design of insulator which it is claimed has many new mertorious features and improvements over the former type.

Youngstown Sheet & Tube Company, Youngstown, Ohio, recently has issued a new illustrated bulletin containing descriptions and prices of its electrical conduit.

Listenwalter & Gough, formerly of 940 Mission Street, now are established in their new quarters at 325 Fifth Street, San Francisco.

Batcheller & Kneen, Inc., consulting engineering firm, has announced the opening of offices at 929 Dexter Horton Building, Seattle. The experience of the firm has been gained in public utility work, financial surveys and industrial projects in California, Alaska and British Columbia.

Moe-Bridges Company, Milwaukee, has taken over the distribution of Aglites made by the Edwin F. Guth Company, St. Louis. The company states it is well equipped with a large stock to handle any orders from its San Francisco office.

The Johnson Washer Company, Oakland, Calif., established in 1902, has just completed a reorganization in which the capital stock has been increased from $75,000 to $500,000. The business of the company has increased considerably in recent years and it is planning on entering new territory.

The Northwestern Electric Company, Portland, has been appointed representative of the Electro-Kold Corporation, Spokane, to handle the sale in Portland of the electric home refrigerator made by that company. This appliance will be sold through the merchandising department of the company which is under the direction of J. C. Plankinton, sales manager.

Hart Parr Company, Charles City, Iowa, recently has placed on the market a new vacuum washer which serves the double purpose of washing clothes and aiding the housewife in canning fruit in season, it is claimed. The tub can hold a day's canning at one time and so eliminates the inconvenience common to cold packing, according to the manufacturer.

A real catch taken from Big Bear Lake and surrounding streams. Reading from left to right: Harvey Tadlock, building contractor and cook; Dan Jones and Paul Cushing, also building contractors, and D. L. Davis, Ontario electragist.

The Message of the Seller

—written for every man who sells anything to the Electrical Industry

EVERYBODY wants to hear the news. But of all the news that's told nothing is more welcome or important than the message of the seller. For ever since the serpent sold Eve the apple—ever since the first human bartered what he found or grew or made for what he wanted, men have been intent upon selling their possessions or their services. And naturally they have been vitally interested to find out what the other fellow had to offer. Actually this practice of selling things has supported the economic world from the very dawn of business.

For Men Must Buy

It's the same in the electrical industry. Nothing can be built, and practically no service can be rendered without buying. The central station must buy boilers, turbines, generators, switchboards, transformers, wire, poles and all manner of equipment, or it cannot grow. No plant can operate for long unless it buys for maintenance. And the manufacturer must buy tools and raw materials and parts with which to make his product. The jobber must continually buy supplies of every kind to keep his warehouse stocked. The contractor must keep on ordering wire and conduit and fittings, or he can't wire buildings. The dealer must perpetually purchase lamps, appliances and other merchandise. And so it goes.

The buyer is incessantly on the lookout for new and better goods. The selling never ceases. Within the electrical industry, therefore, there is no activity more fundamental than this continual buying and selling, this never ceasing interchange of commodities between electrical men. And there is no feature of this selling more important than the telling of the seller's story.

To Tell the Story

How can the seller best tell this story that the buyer wants to hear? That is a big problem today.

In the beginning it was simple enough. When a man made an extra pair of shoes, he walked down the lane to his neighbor's farm and offered to swap them for a bag of wool. The seller and the buyer talked it over. But business is no longer simple barter. The world is wide, the electrical industry is great and scattered. Men who have goods to sell can't travel everywhere continually and talk face to face with every buyer.

They can't write personal letters to everybody all the time and tell each buyer all about the things they have to sell. If they did so, often enough to keep the buyer's memory green, they would go bankrupt.

Well, what *do* they do?

An Audience at Hand

They fall back on the institution of the press. And they find right there the practical solution of the problem.

For just as the newspapers of a city tell the merchant's story to the men and women of the civic community—so the industrial paper tells the manufacturer's story to the men and women of the industrial community.

The seller can send his message through an electrical paper directly and economically. Thus their common necessary habit of reading gathers the buyers of the electrical industry together into one great audience that every seller in the industry may talk to—if he knows how.

Just shut your eyes and picture what kind of people there are there in that audience. They divide naturally into six groups. They are—

Central station executives, engineers, operating officials, and department heads.

The great army of consulting and constructing electrical engineers.

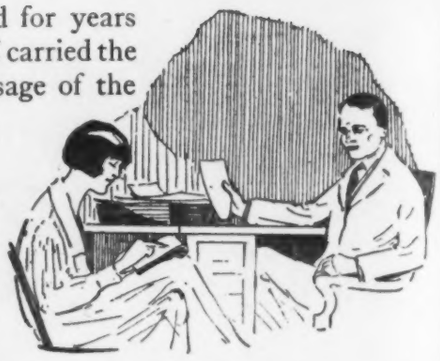
Electrical manufacturers and their chief men.

Electrical jobbers and their staffs.

The electrical contractors of all towns and cities.

The electrical and radio dealers of all communities.

In the early days—half a century ago—the number of men engaged in the electrical industry were so few and their problems were so kindred that one electrical paper was enough for all, and for years the *Electrical World* carried the news and the message of the seller to the whole electrical audience. But times have changed and more and more people have come into this audience so that today there are six specialized McGraw-Hill electrical papers with over one hundred thousand readers. These are the thinkers and the doers and the buyers of the entire industry.



As each group has grown in the importance of its specialized interests and in its buying power and activity, it has become more intensively concerned with certain kinds of news and dependent upon specific classes of sellers. It is to serve these groups and the men from whom they buy, that the other papers have been gradually developed—one after the other as the need for each has grown.

Reaching the Groups

To any man who knows the electrical industry—as one must know his market in these days—a clear definition of the precise character of the special segregated audiences to which these six McGraw-Hill electrical papers now carry the message of the seller, should be of particular interest. It is set down here to present a key and guide to any manufacturer, that will point out to him the way to reach the very buyers that he wants to sell.

Electrical World—

published weekly, the "master" executive and engineering paper, the weekly newspaper of the electrical industry, written alike for the central station man, the electrical engineer, the electrical manufacturer and jobber and the large contractor, reflecting broadly the activities, problems, opinions, and progress of all groups of the industry.

With its 18,500 subscribers, *Electrical World* carries the message of the seller to 100 per cent of

all the central stations of the country having a generating capacity above 5,000 kw., to 82 per cent of all stations from 1,000 to 5,000; and to over half of all the little plants below that size. It reaches over 99 per cent of the buying power of the central station industry, the principle executives and engineers of industrial and electrical manufacturing companies, the important engineers engaged in consulting, contracting and sales and other thousands in influential allied occupations.

Electric Railway Journal—

a weekly devoted entirely to the service of those electrical men who are enaged in the street railway industry.

The circulation of the *Electric Railway Journal* reaches about 7,000 men representing 98 per cent of the track mileage of the electric railway industry of America, 99 per cent of the rolling stock employed and 100 per cent of the buying power.

Electrical Merchandising—

published monthly for the commercial executive, the appliance sales manager and the salesman of the central station, for the electrical dealer and contractor, and for the jobber and manufacturer of appliances, lighting equipment and wiring material.

With its 15,000 copies, *Electrical Merchandising* serves the vast distribution field that annually sells $2,000,000,000 of electric merchandise, appliances and supplies to the American public. Its subscribers number central station merchandising executives and salesmen, electrical contractors and contractor-dealers, electrical appliance stores, electrical manufacturers and jobbers and their agents and salesmen.

Industrial Engineer—

a monthly, talking directly to men of the large industrial works of the country, describing and discussing the operation and maintenance of electrical and associated mechanical equipment.

The 12,750 subscribers to *Industrial Engineer*, include works managers, superintendents, department heads and their assistants, contractors, jobbers and dealers who specialize in electrical service and materials used by mills and factories; and other industrial men interested in electrical operation and maintenance.

Journal of Electricity—

a semi-monthly publication specifically edited for the great electrical community of the Pacific Coast, as their local electrical industry paper.

Journal of Electricity serves a limited locality but one with tremendous electrical buying power. Its 5,100 copies cover the central station and electric railway companies, manufacturers, jobbers and important contractors, dealers and other electrical men of the Pacific Coast.

Radio Retailing—

the monthly business magazine of the radio industry—serving all dealers and jobbers who sell radio sets, accessories and parts.

Radio sales for 1924 totalled $350,000,000, and the volume is still increasing. Ten different classes of stores are handling radio today—

1—exclusive radio shops, 2—electrical dealers, 3—electric light and power companies, 4—music and phonograph shops, 5 — sporting goods dealers, 6—hardware stores 7 — furniture stores, 8 — automobile supply stores, 9—department stores, 10—chain stores, drug stores, etc. To bring the best radio merchandising methods and selling ideas to these widely differing groups of merchants, all of whom have a common problem in their sales of radio, *Radio Retailing* was established by the McGraw-Hill Co. beginning January, 1925.

Power—

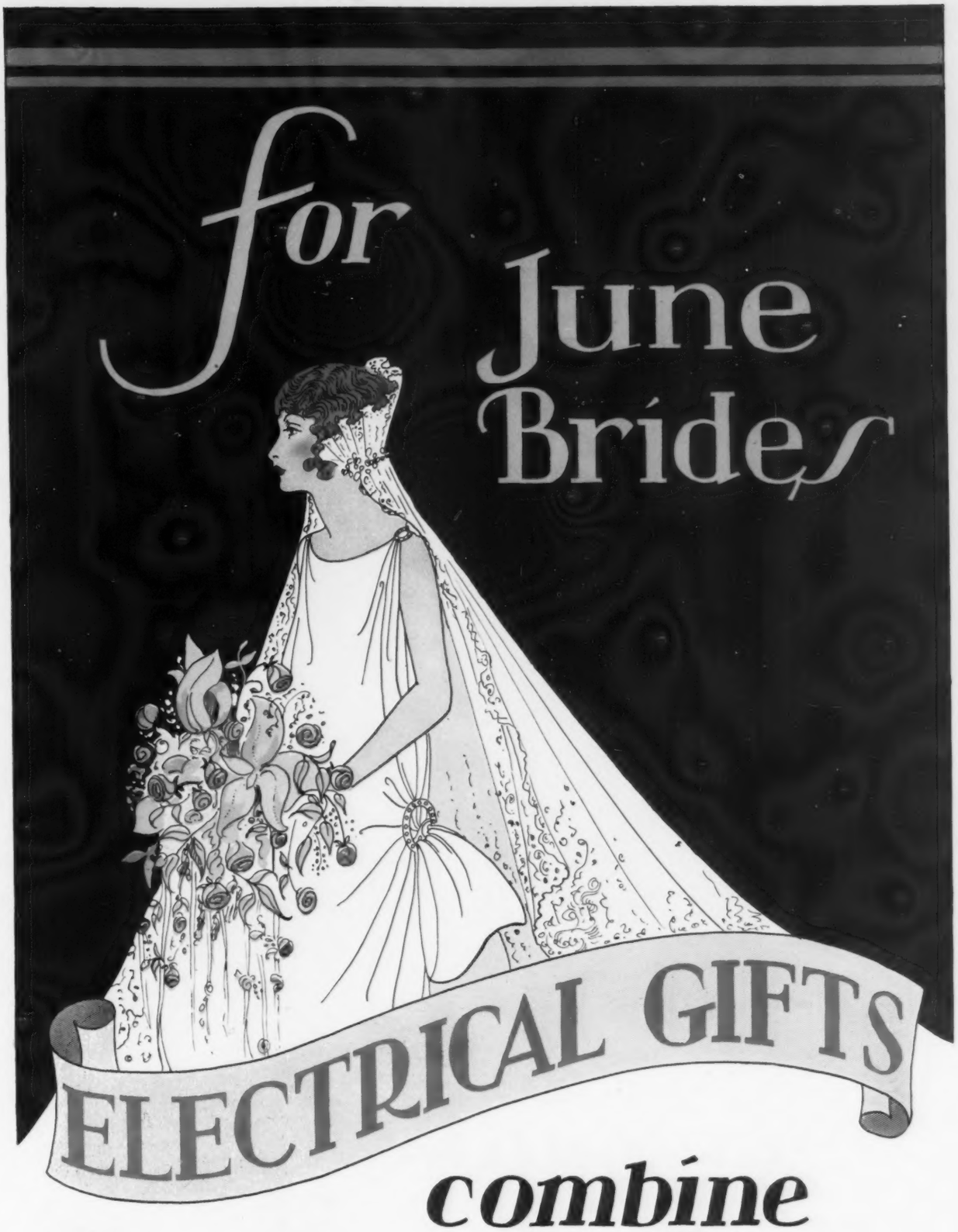
also should be mentioned although it is not an electrical paper, because for years it has devoted space each week to practical electrical problems of the industrial and private plant, written especially for men who have come up through the steam end of the business. It reaches 30,000 readers.

Week by week and month by month, year after year, these McGraw-Hill electrical publications travel out across the land, and to Canada and Mexico, to Europe and the Far East and South, carrying the news of the electrical industry to electrical men wherever they may be. With the news goes the message of the seller — a service as vital to the buyer as to the man from whom he buys.

Together these six McGraw-Hill papers provide a priceless service to the man who sells. They carry his message to 100,000 of the most important men in the electrical industry and give him a continuous contact with this selected audience of the very buyers to whom he wants to tell his ever changing story.

"The common necessary habit of reading gathers the buyers of the electrical industry together into one great audience that every seller in the industry may talk to—if he knows how."

AS a further contribution to help guide the message of the seller out to the electrical industry, the McGraw-Hill Company also publishes the McGraw Central Station Directory, the McGraw Electric Railway Directory and the Radio Trade Directory—serving the fields of the Electrical World and Electrical Merchandising the Electric Railway Journal and Radio Retailing respectively.



combine
Beauty with Service

The above is a reproduction of the large poster being issued by the California Electrical Bureau, Rialto Bldg., San Francisco. Display it in windows and on counters. If you haven't a supply of display matter, write the Bureau now.

ELECTRICAL GIFTS FOR THE BRIDE

Hotpoint

Now $5.00

The New Hotpoint Model "R"

Sell Wedding Gifts that Serve

The Famous Hotpoint With Improvements

Has the large red Thumb Rest and all other famous Hotpoint features, including attached Heel-stand, hinged plug and the *Hot Point*. Weight 6 lbs. The finest iron money can buy! Price,

$6.00

When you sell electric wedding gifts you are selling the electric convenience idea into hundreds of new households. That's the sales message of Bride's Week. And for the Hotpoint dealers it is a golden opportunity.

As a leader of the complete line of Hotpoint electric appliances there's the new Model R iron selling at $5 list. It's a real Hotpoint 6-lb. model with all the features and high quality that have made the Hotpoint irons the leader for twenty years.

Display, boost and sell Hotpoint appliances during Bride's Week and you'll start new households off right.

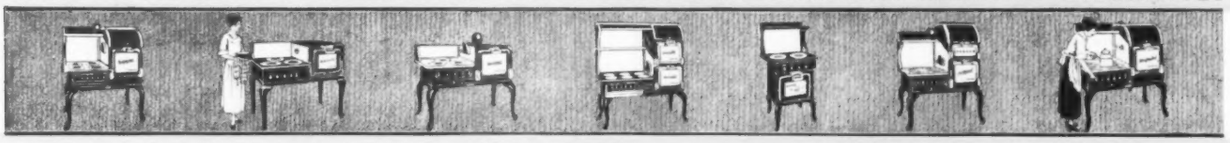
EDISON ELECTRIC APPLIANCE CO., Inc.

Pacific Coast Factory, Ontario, California

BOSTON · NEW YORK · CLEVELAND · ATLANTA · CHICAGO
ST. LOUIS · SALT LAKE CITY · ONTARIO, CALIF.
Canadian General Electric Company, Ltd., *Head Office*, Toronto

5620 West Taylor Street : Chicago, Illinois

WORLD'S LARGEST MANUFACTURER OF HOUSEHOLD ELECTRIC HEATING APPLIANCES



THERE'S A HOTPOINT ELECTRIC RANGE FOR EVERY PURSE AND PURPOSE

ROCKBESTOS

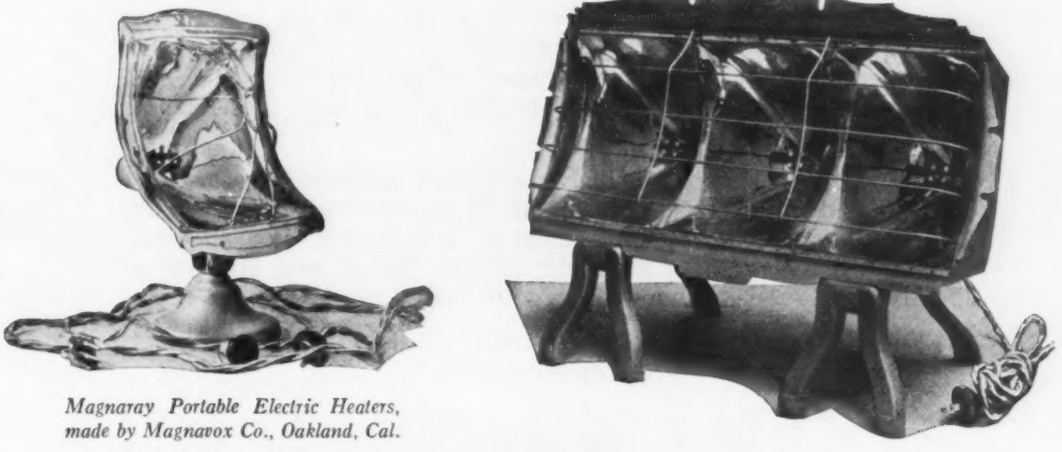
–the asbestos covered wire

Possesses the Highest Quality

Discriminating manufacturers are including Rockbestos, the asbestos covered wire, as equipment for all types of electric appliances.

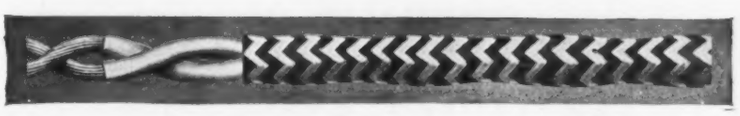
When the Magnavox Company planned the fine new line of Magnaray Portable Electric Heaters, they selected Rockbestos heater cord to be a part of the equipment because, as Mr. J. Schoenfeld, engineer of the heating division said—

> "Rockbestos heater cord possesses the highest quality which is the principle on which Magnaray heaters are built, and we are equipping them exclusively with Rockbestos."



Magnaray Portable Electric Heaters, made by Magnavox Co., Oakland, Cal.

Specify Rockbestos, the everlasting wire. Samples sent cheerfully.

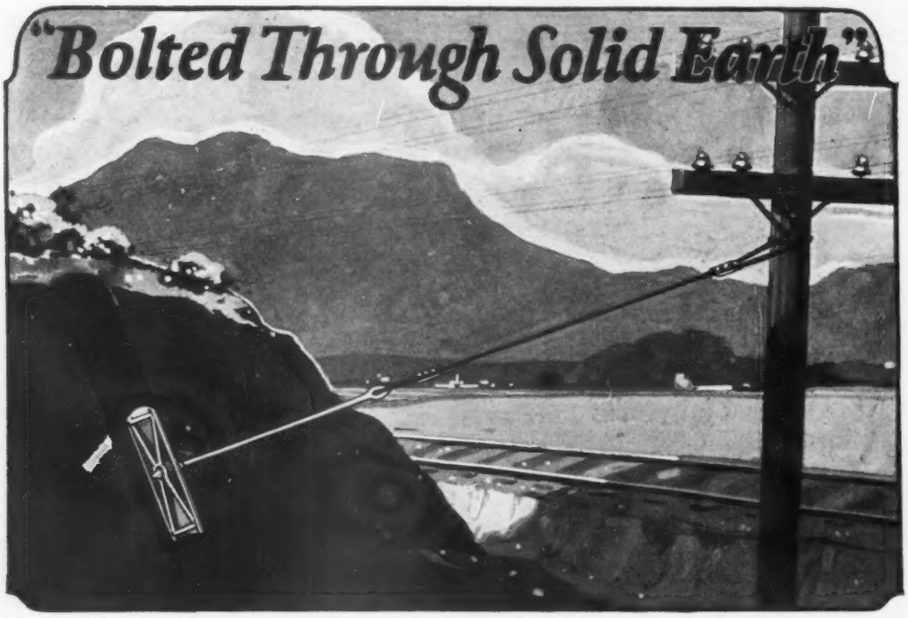


BAKER-JOSLYN COMPANY

DISTRIBUTERS

ELECTRICAL EQUIPMENT & CONSTRUCTION MATERIALS

330-32 AZUSA ST., LOS ANGELES SECOND & BRYANT STS., SAN FRANCISCO 2424-28 FIRST AVE. SO., SEATTLE



Wet Weather Does Not Loosen a Never-Creep

It is Bolted through Solid, Undisturbed Earth

Poles anchored by Never-Creep Anchors are practically as solid in wet weather as they are in dry. Unlike wooden "deadmen" or other types of anchors installed in pits, the pull on the Never-Creep Anchor is directed through undisturbed earth.

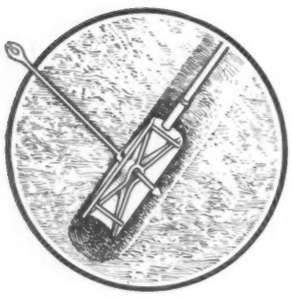
The holding power of Never-Creep Anchors is practically unaffected by weather conditions because the earth which the Never-Creep pulls against is undisturbed, not dug out and replaced. As a matter of fact, when you stick in a Never-Creep Anchor you forget it for all time.

Never-Creep Anchors are made in different sizes to meet the various strain requirements.

Manufactured by

CHANCE COMPANY

CENTRALIA, MO.



PACIFIC STATES ELECTRIC COMPANY

SAN FRANCISCO LOS ANGELES OAKLAND PORTLAND SEATTLE SPOKANE

Pacific Coast Sales Agents

Identifies Quality Electrical Merchandise
THE "Check" Seal OF PACIFIC STATES ELECTRIC COMPANY
and Reliable Contractors and Retailers

"A Pacific Coast Product"

The Oakland Plant of the Illinois Wire and Cable Co. Is Now Producing Weather Proof Wire and Cable for Pacific Coast Consumers

The above photograph shows the first unit of the new Oakland plant of the Illinois Wire and Cable Company which is now producing weather proof wire and cable for the Pacific Coast trade.

The establishment of this plant gives Western consumers factory service on these products and insures prompt deliveries of not only standard sizes but on any special sizes which may be needed.

The first unit of this plant has been designed to take care of the present requirements of the Pacific Coast on these products but units will be added as demand develops.

The Oakland Plant contains the specially designed equipment used in our Eastern plant. This fact coupled with excellent working conditions insures the highest quality for our products.

ILLINOIS WIRE AND CABLE CO.

Oakland, California

PACIFIC STATES ELECTRIC COMPANY

SAN FRANCISCO LOS ANGELES OAKLAND PORTLAND SEATTLE SPOKANE

Distributors for the *Pacific Coast*

"Check" Seal

Hubbard Hardware

There is a Peirce Rack for Every Secondary Job

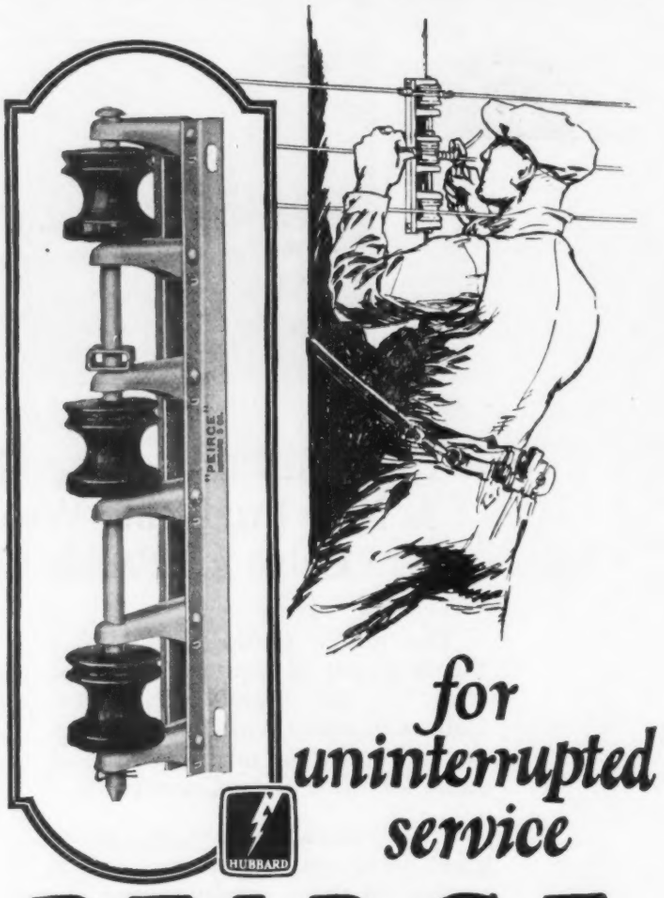
When secondaries are tied to Peirce Racks uninterrupted service is assured. All Peirce Racks are made from new rolled open hearth steel and are designed so that the point of fastening is in direct line with the strain, thus developing the full strength of the metal used.

They are made in six types; Standard type, Extended Back type, Light Presteel type, Heavy Presteel type, Horizontal type and Huff type.

These Racks are supporting dead end loads of 500,000 C.M. weather-proof cables on spans of 100 feet and are carrying cables as large as 1,000,000 CM. on spans up to 150 feet in length without a single rack having failed in service.

These Racks are described complete in Bulletin No. 3 (Write for it today.)

Sold exclusively and carried in stock by the leading electrical jobbers.



for uninterrupted service

PEIRCE
Secondary Racks

HUBBARD & COMPANY

Pittsburgh Chicago Oakland

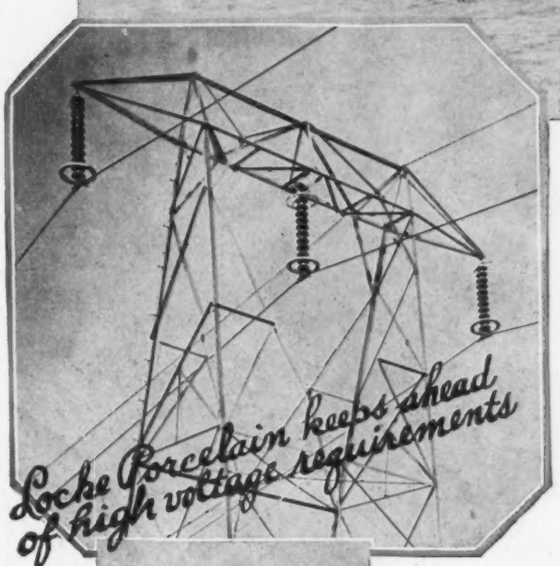
PACIFIC STATES ELECTRIC COMPANY

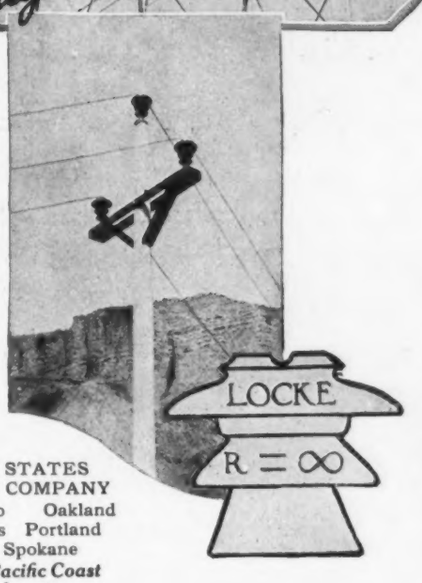
SAN FRANCISCO, LOS ANGELES, OAKLAND, PORTLAND, SEATTLE, SPOKANE

Distributors for Identifies Quality Electrical Merchandise and Facilitates Contractors and Builders THE Check Seal OF PACIFIC STATES ELECTRIC COMPANY *the Pacific Coast*

Locke Insulators keep pace with Electric Service demands

Where the irresistible force meets infinite resistance





THE historic struggle between the Monitor and the Merrimac was the first engagement between armored battleships. It is recorded that the contest was a draw; but science has carried on the conflict for sixty years—seeking an ultimate decision between the opposing forces of heavy armament and high explosives.

In the field of electricity during the past thirty years, a condition similar to this has taken place. The transmission of power at steadily increased voltages and over greater distances has introduced many vexatious problems in the design and manufacture of porcelain insulators to those who must keep pace with electric service developments.

The apparent limit of 60,000 volts for insulator capacity which existed in 1903—has been increased four-fold by new designs and greatly improved porcelain. And now engineers are anticipating operating voltages of more than double the present maximum.

Locke Porcelain, the first ever used, has continued to pioneer the way in all the important improvements of recent years. And it is our pledge that Locke Insulators, made from Locke Porcelain, will continue to meet the most exacting demands of the future.

LOCKE INSULATOR CORPORATION
Baltimore, Md., and Victor, N. Y.

PACIFIC STATES ELECTRIC COMPANY
San Francisco Oakland
Los Angeles Portland
Seattle Spokane
Exclusive Pacific Coast Sales Agents

LOCKE
PORCELAIN

P&S Chain Pull Sockets

For Better Wiring

The Aristocrat

Appearance

While maintaining characteristic neatness and utility, new requirements are met by the P&S CHAIN PULL SOCKET

A Distinct Advantage

Features that are Inbuilt and Independent of the Chain—mark a distinct advance in Pull Socket Design

Standard Chain is Employed

These Features permit the use of Standard Chain—without inconvenient attachments—and insure the proper operation of the Socket

Tested With Full Current Load

Every device with moving parts is TESTED with FULL CURRENT LOAD before leaving the factory

Pass & Seymour, Inc. Solvay Station **Syracuse, N. Y.**

A Contribution to the Development of Industrial Lighting

The lighting needs of industry and the rapid development of incandescent lamp design and manufacture have made necessary frequent changes in lighting equipment.

Benjamin has answered the call of industry through the invention of the threaded socket and accessory lighting equipment.

For each size of lamp and for each kind of service there is Benjamin Threaded Equipment to meet the need.

This Benjamin Threaded Equipment has been of immeasurable value to industry in enabling manufacturers to adopt new sizes of lamps, to easily and conveniently change sizes and types of reflectors, without disturbing the wiring.

In addition to this it has increased economy and maintenance through provision for easy wiring and easy cleaning.

These threaded sockets are for either stem suspension or attachment to ceiling outlet boxes, and are in keyless or straight-down, "inner-pull" pull-chain types.

BENJAMIN
Makers of Things More Useful

Threads!

Benco Sockets

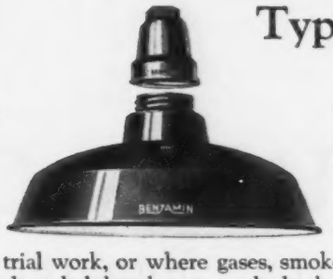
Weatherproof, highly insulated metal-cased general purpose sockets for indoor and outdoor use. The great sturdiness of the socket, the threaded feature making it possible to use Benjamin holders and reflectors, combined with the low price, have made it the general utility choice in thousands of industrial plants.

Threads!

Ben-ox

Provides a heavier duty, highly insulated socket for use with the larger lamps and reflectors. With Ben-ox the wiring is completed, regardless of accessory equipment, eliminating soldered and taped joints. By means of the Ben-ox Thread a wide range of Reflectors, Holders and Connectors may be screwed in to meet present requirements or to anticipate future needs. For both Industrial and Commercial Illumination.

Threads!



Type RR Threaded Equipment

For railroads, steel mills and other plants, where an extremely rugged equipment is required to withstand rough handling and severe service incident to very heavy industrial work, or where gases, smoke and vapors are present. The threaded hoods are made both for stem suspension and for attaching to ceiling outlet boxes, in both cast and porcelain enameled steel. The threaded reflectors make cleaning easy and keep down maintenance costs. With Mogul bases for the larger lamps.

For your industrial lighting needs look into Benjamin Threaded Equipment. Our nearest office will gladly give you full information.

Benjamin Electric Mfg. Co.

120-128 So. Sangamon St., Chicago

New York
247 W. 17th St.

San Francisco
446 Bryant St.

SUPERIORITY

Superiority in its field is attained by any product only when, through constant refinement of design and careful scrutiny of method, even the minutest detail is made as nearly perfect as the present knowledge of the art will allow. Examine a Duncan Model M-2 Watthour Meter, or send for a bulletin on this model and study it thoroughly and it will be evident why Duncan meters have such an enviable record for accuracy, at the start and sustained through years of use. In accessibility of parts for inspection, cleaning or the adjustment rarely needed, Duncan is also without equal. The current advertising in this Journal of Duncan is enlarging on these details in an interesting and illuminating way. The whole story is contained in our bulletins No. 118 and 128 which will gladly be sent upon request.

D U N C A N

Electric Manufacturing Co.

Lafayette, Indiana

PACIFIC COAST REPRESENTATIVES:

A. F. Blecksmith
534 Bryson Bldg., Los Angeles, Cal.

E. H. Albrecht
310 Lewis Bldg., Portland, Oregon

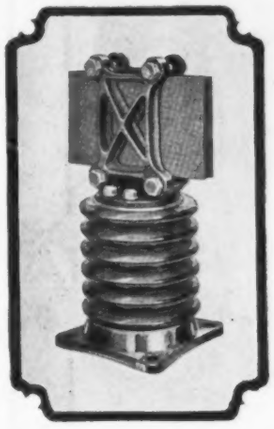
Champion Signifies Dependability

COMPLETE interchangeability is one of many outstanding advantages found in Champion Indoor Bus Supports. It helps materially to avoid long interruptions of service. It also reduces costs, because the maintenance of excessive stock is no longer necessary.

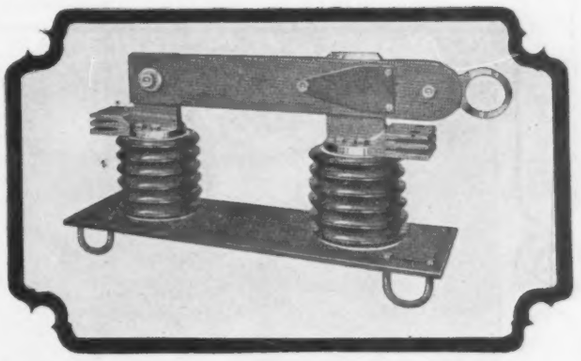
Due to Champion's simplified construction, a comparatively small stock is all that is needed to meet any emergency—a few porcelains, various sizes of bar, cable or tube clamps and style bases. Power engineers will find these sufficient to assemble any combination on quick notice for changes or minor extensions.

The interchangeable feature of the insulators, particularly, is an advantage that has been quickly recognized.

If by reason of any abnormal conditions the porcelains become damaged they can be easily removed and replaced. This is quickly accomplished by means of machine bolts which form a permanent gripping assembly with the aid of brass bushings embeded in corrugated holes of the insulators. Thus there are no cemented joints to crack or crumble under vibration or mechanical impact.



Additional Champion service can be had in all types of outdoor equipment, choke coils, etc.,—all of the most modern type and offering strong, substantial designs. Write for Bulletin B and prices.



CHAMPION Indoor Disconnecting Switches embody new features of design and an exceptionally high quality of materials and workmanship.

Power engineers are finding these characteristics well worth careful study because they assure greater dependability and a higher degree of economy of maintenance than is commonly available.

The insulators are built exclusively of solid one-piece porcelain by the casting process of the J-D Insulator Company and are completely interchangeable for all types of bus supports and switches.

A highly valuable feature is the one-piece, drop-forged, pure copper hinge and contact clips, generously proportioned. A self-adjusting blade maintains uniform pressure on the contact surfaces without chafing the copper of the blade on the corners of the clip. All danger of imperfect contact is eliminated.

The complete Champion organization is always at your service and ready to help solve your special switching problems. Write for Bulletin C and prices.

THE CHAMPION SWITCH COMPANY—550 ABBOTT ROAD—Post Office Box 816—Buffalo, N. Y.

SALES REPRESENTATIVES

Garland Affolter Engineering Company
Rialto Building San Francisco, California

Garland Affolter Engineering Company
I. W. Hellman Building Los Angeles, California

Garland Affolter Engineering Company
Alaska Building Seattle, Washington

Champion Switch Company
Rooms 510-512 2 Rector St. New York City

A. H. Savage & Company
914 Pioneer Building St. Paul, Minnesota

T. W. McKay
Manitoba Power Co., Ltd., Winnipeg, Can.

Ralph D. Ernest
205 Kresge Building Detroit, Michigan

Champion Switch Company
412-413 Glenn Building Atlanta, Georgia

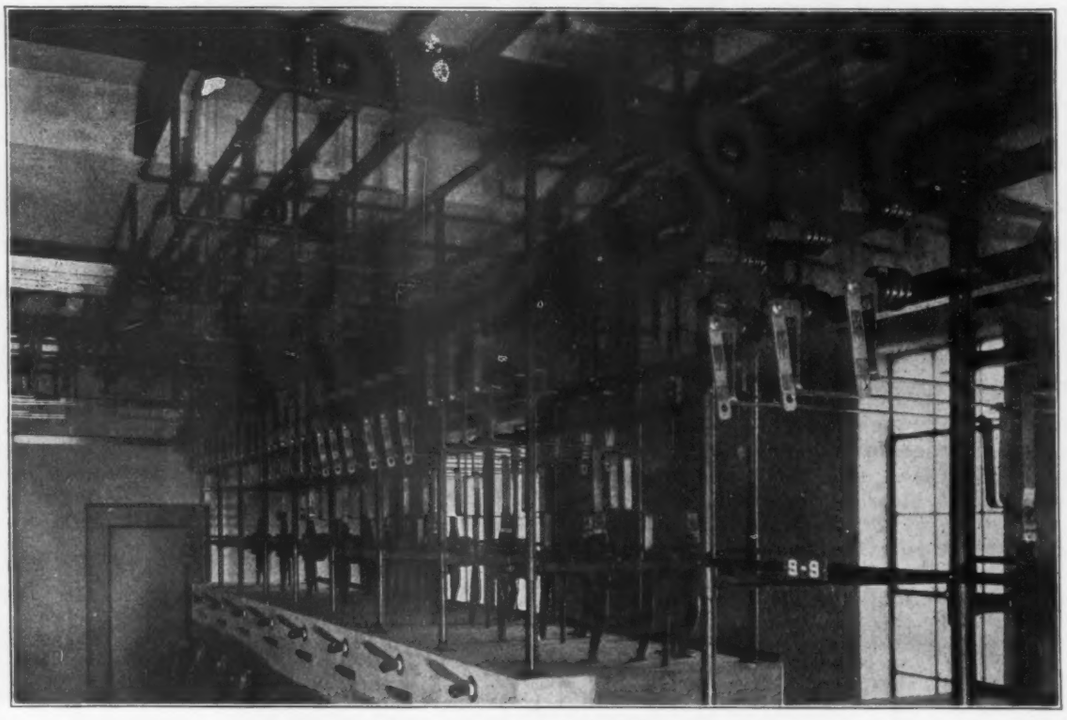
Champion Switch Company
924 Marquette Building Chicago, Illinois

The CHAMPION SWITCH COMPANY

THE STANDARD OF COMPARISON

The Delta Star

UNIT TYPE



UNIT TYPE BUS SUPPORTS AND DISCONNECT SWITCHES

If you want a STANDARD, use Unit Type.

The insulators used on the disconnect switches and bus supports of this 1924 installation are not only interchangeable with each other but are also interchangeable with those shipped in 1912.

Where standards are important—you know what to buy.

DELTA-STAR ELECTRIC CO.

2400 Block Fulton St Chicago, Illinois

Albany, N. Y., 715 City Savings Bank Bldg.
Birmingham, Ala., 827-830 Brown-Marx Bldg.
Boston, Mass., 294 Washington St.
Buffalo, N. Y., 595 Ellicott Square
Columbus, Ohio, 600 Joyce Realty Bldg.
Detroit, Mich., 708 Ford Bldg.
Indianapolis, 518 Trac. Term. Bldg.
Kansas City, Mo., 301-2 Dwight Bldg.
Knoxville, Tenn., Holston Nat'l Bk. Bldg.
Los Angeles, Calif., I. W. Hellman Bldg.
Minneapolis, Minn., 940 Security Bldg.
New York, N. Y., 25 Broad St.
Orlando, Fla., Cornell-Mathews Co.
Philadelphia, Pa., 1333 Real Estate Trust
Pittsburgh, Pa., 934 Union Trust Bldg.
Rochester, N. Y., 119 Main St., E.
Salt Lake, Utah, 313 Dooly Bldg.
San Francisco, Calif., 193 Second St.
Seattle, Wash., Hoge Bldg.
St. Louis, Mo., Railway Exchange
Syracuse, N. Y., City Bank Bldg.
Toronto, Ont., 213-219 Sterling Rd.
Berthon & Touzot, 40 Rue de Aguisseau, Boulogne-sur-Seine, France
Carrick, Wedderspoon, Ltd., Christchurch, New Zealand
A/S Kraftoverforing Kristiania, Norway
Allenwest, S. A., Ltd., City House, Johannesburg, So. Africa
Allied Engineering Ltd., Sydney, Australia

UNIT TYPE CEMENTED SWITCH INSULATORS

ALLIS-CHALMERS

Power Transformers
Made in types Absolutely Reliable for every Application

2500 KV-A, 66,000 V. single phase, 60 cycle, oil-insulated, self-cooled outdoor type Transformer.

ALLIS-CHALMERS PRODUCTS
Electrical Machinery
Steam Turbines
Steam Engines
Gas and Oil Engines
Hydraulic Turbines
Crushing and Cement Machinery
Mining Machinery

ALLIS-CHALMERS MANUFACTURING COMPANY

MILWAUKEE, WISCONSIN. U.S.A.

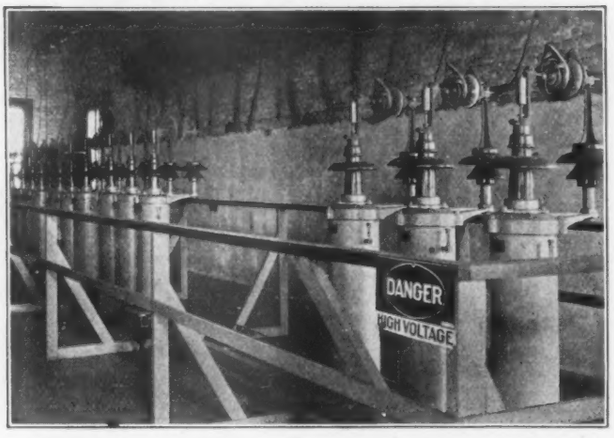
ALLIS-CHALMERS PRODUCTS
Flour and Saw Mill Machinery
Power Transmission Machinery
Pumping Engines-Centrifugal Pumps
Steam and Electric Hoists
Air Compressors - Air Brakes
Agricultural Machinery
Condensers

The Bennett Arrester

for the good of the Service

ELPEC

It has no fire hazard



HAVING no fire hazard, Bennett Lightning Arresters may be installed on station roof or in a switch room without danger to adjacent structures or apparatus. They are peculiarly suitable for protecting the separate low-voltage circuits of exciters and other auxiliaries in the large modern station.

Bennett Lightning Arresters may be used indoors for the protection of rotary converters, station busses, distribution systems, etc.

Bulletin 601 illustrates the various arresters for such services—giving also full details on the Bennett principle—and its advantages.

A copy of the Bulletin 601 will be mailed you promptly on request.

DISTRICT REPRESENTATIVES:

Electrical Engineering & Mfg. Co.,
907 Penn Avenue,
Pittsburgh, Pa.

Electrical Engineering & Mfg. Co.,
320 Union Building,
Cleveland, Ohio.

Electrical Engineering & Mfg. Co.,
604 Mercantile Library Building,
Cincinnati, Ohio.

J. W. Fraser & Co.,
603 Commercial Bank Building,
Charlotte, N. C.

E. A. Thornwell,
Candler Building,
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Captain Harold E. Bell,
P. O. Box No. 6811,
Johannesburg, S. A.

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Goodyear & Hammersley, Inc.
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P. O. Box 394,
Huntington, W. Va.

Mr. O. T. Hall,
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Mr. C. E. Ingalls,
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Ferranti Meter & Trans. M'g. Co.,
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Ferranti Meter & Trans. Mfg. Co.
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Mr. C. M. Ferguson,
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Rumsey Elec. Co.,
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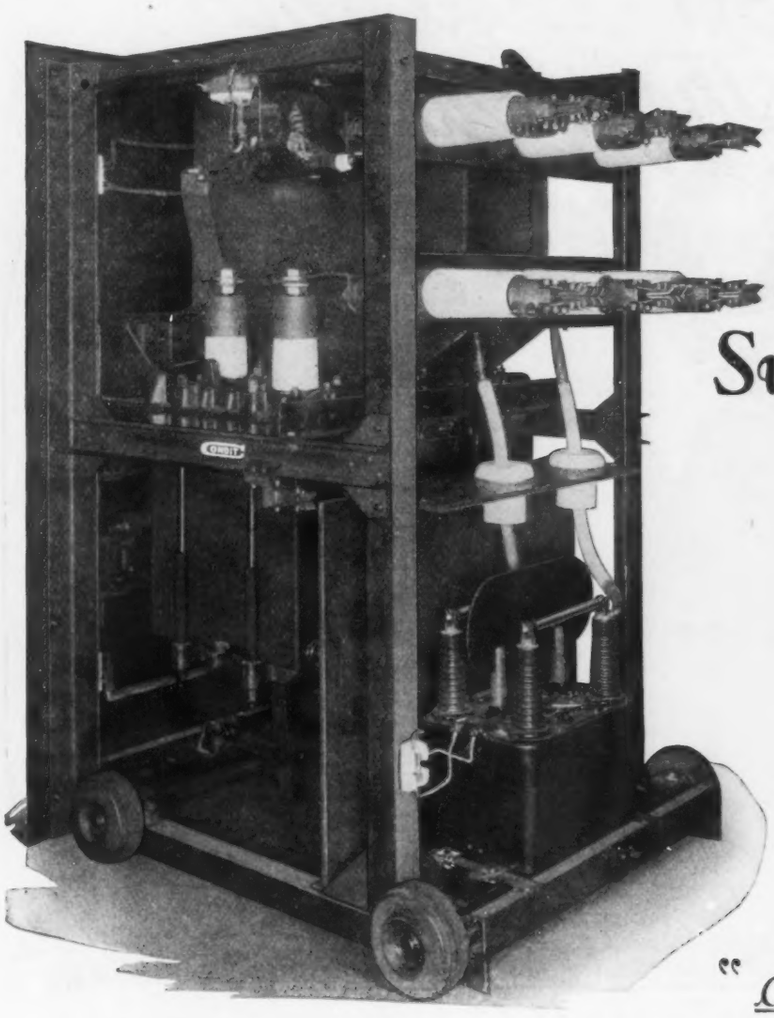
Minneapolis, Minn.

Mr. A. L. Searles,
Michigan Trust Building,
Grand Rapids, Mich.
and
808 Donovan Bldg.,
2457 Woodward Ave.
Detroit, Mich.

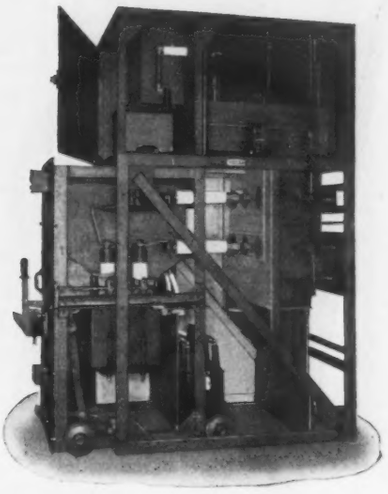
Mr. E. E. Van Cleef,
53 W. Jackson Blvd.,
Chicago, Ill.

H. I. Skilton, 516 National Bank Bldg., Havana, Cuba

CONDIT Truck Type



Safety Enclosed Switchboard



"Get in touch with Condit"

FOR Continuity of Service and Ease of Installation, Accessibility, Strength, Operating Efficiency and Extreme Safety, use the Condit Safety Enclosed Switchboard with removable truck type panels.

Housing and truck are of heavy, reinforced steel angle construction. The truck is provided with removing and replacing bar and adequate mechanical interlocks. A steel panel carries the face plate for manual or electric operated circuit breakers, meters, indicating lamps, etc. Automatic shutters prevent accidental contact with current carrying parts when the truck is removed. Condit design and construction superiority is evident throughout..

Send for Bulletin No. 457

CONDIT ELECTRICAL MFG. CO.
Manufacturers of Electrical Protective Devices
South Boston, Mass.

Represented by The H. B. Squires Co. in Seattle, San Francisco and Los Angeles

HOME LIGHTING CONTEST

CONDIT

7545

Written into the Industry's Progress 1924

—into the H&H Catalogue

TWO PAGES out of thousands!—they sum up the year. More real service to the Industry, there, than in countless pages of commonplace items from everywhere.

The almost epoch-making step to *Adjustable* Candle Sockets: that alone would proclaim the leader in the whole field of Wiring Device development.

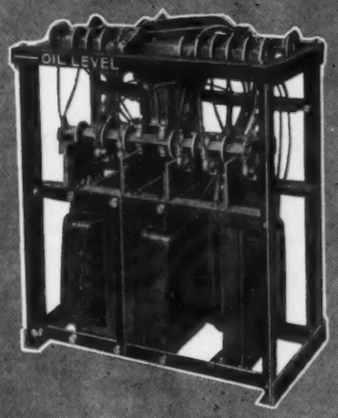
To the extent that you've used or specified H&H products, you've contributed to this great record. You've supported our work, to make *your* work easier and more profitable.

New things are yours—ranking first among wiring devices; written first into the H&H Catalogue; delivered first to you who value that catalogue.

Working not only for what we can get from the industry, but what we can give to the industry.

THE HART & HEGEMAN MFG. CO. HARTFORD, CONN.

High Voltage



A New, High Voltage, Automatic Compensator

It is push button operated and the push button works on a low voltage circuit independent of the high voltage circuit.

Push the starting switch and the motor is started with reduced voltage and after it has reached a speed where it is safe to be thrown across the line, the Automatic Compensator takes care of this.

Push the stop switch to stop the motor.

Additional start and stop stations can be installed at different points so that accidents to the machinery can be prevented.

It does not require an enclosing cabinet because the case is dead electrically.

It is weatherproof, dustproof, vapor proof, gas proof and can therefore be mounted anywhere either indoors or outdoors.

It is totally immersed in oil.

It can be mounted near the motor or in any location where space is not valuable.

Overload protection is furnished to protect the motor against overloads due to overloading the motor or due to single phasing.

It is so rugged and reliable that inspection once or twice a year is all that is necessary.

Write for Bulletin 1047

THE ELECTRIC CONTROLLER & MFG. CO.

CLEVELAND, OHIO

FOR SOUTHERN CALIFORNIA: THOMAS MACHINERY CO. AMERICAN BANK BLDG. LOS ANGELES

FOR STATES OF OREGON AND WASHINGTON: W. MONTELIUS PRICE, SEATTLE, WASH.

FOR NORTHERN CALIFORNIA: C. F. HENDERSON, CALL BLDG., SAN FRANCISCO

A WOODS SCENE AT OUR NAPLES, IDAHO OPERATION

McFARLAND "SERVICE BRAND"
RED CEDAR POLES
"THEY STAY PUT"

Live, Healthy, Straight Trees

Is the First Requisite for Supplying High Quality Poles

Complete Stocks of Seasoned Poles
Available for Immediate Shipment
All Standard Treatments

L. D. McFARLAND CO., Ltd,
Sandpoint, Idaho

MAYDWELL & HARTZELL
OUR NAME MAYDWELL SPELLS QUALITY
INCORPORATED

SALES REPRESENTATIVES

158-168 Eleventh St.
San Francisco

455 Colyton St.
Los Angeles

A Prosperous Year Ahead

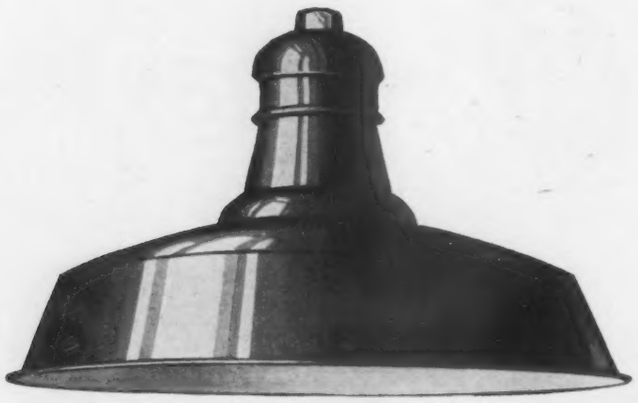
All signs point to a happy and prosperous 1925. Newspapers and magazines throughout the country already have recorded how business has improved.

We, in the West, and that portion of Western business which helps record a heavy credit to the prosperity column, under the listing of "electrical industry," can be especially optimistic in regard to the outlook for 1925.

According to figures available at this time, the total sum to be expended in hydro-electric projects in the eleven Western states for the year 1925 will approximate $100,000,000. The expenditure of this vast sum, coupled with the heavy snowfall in our Western mountains, and the general rainfall during the last month of 1924, should mean a highly prosperous electrical year for Western electrical industry and the Western electrical jobber and contractor-dealer.

In this indicated prosperity the Westinghouse organization, and particularly its Western personnel, wishes a widespread sharing of the good times to its many friends.

Westinghouse



Just Suppose-

that you wanted to illuminate a machine shop in which the work performed is of medium grade—that is, there is no very fine work demanded. The floor space is 80 by 120 feet, and the ceiling is 12 feet high. The walls are tan and the ceiling is white. How many foot-candles would you specify? How many reflectors would you install? What type of reflector would you select? How would you space the lamps?

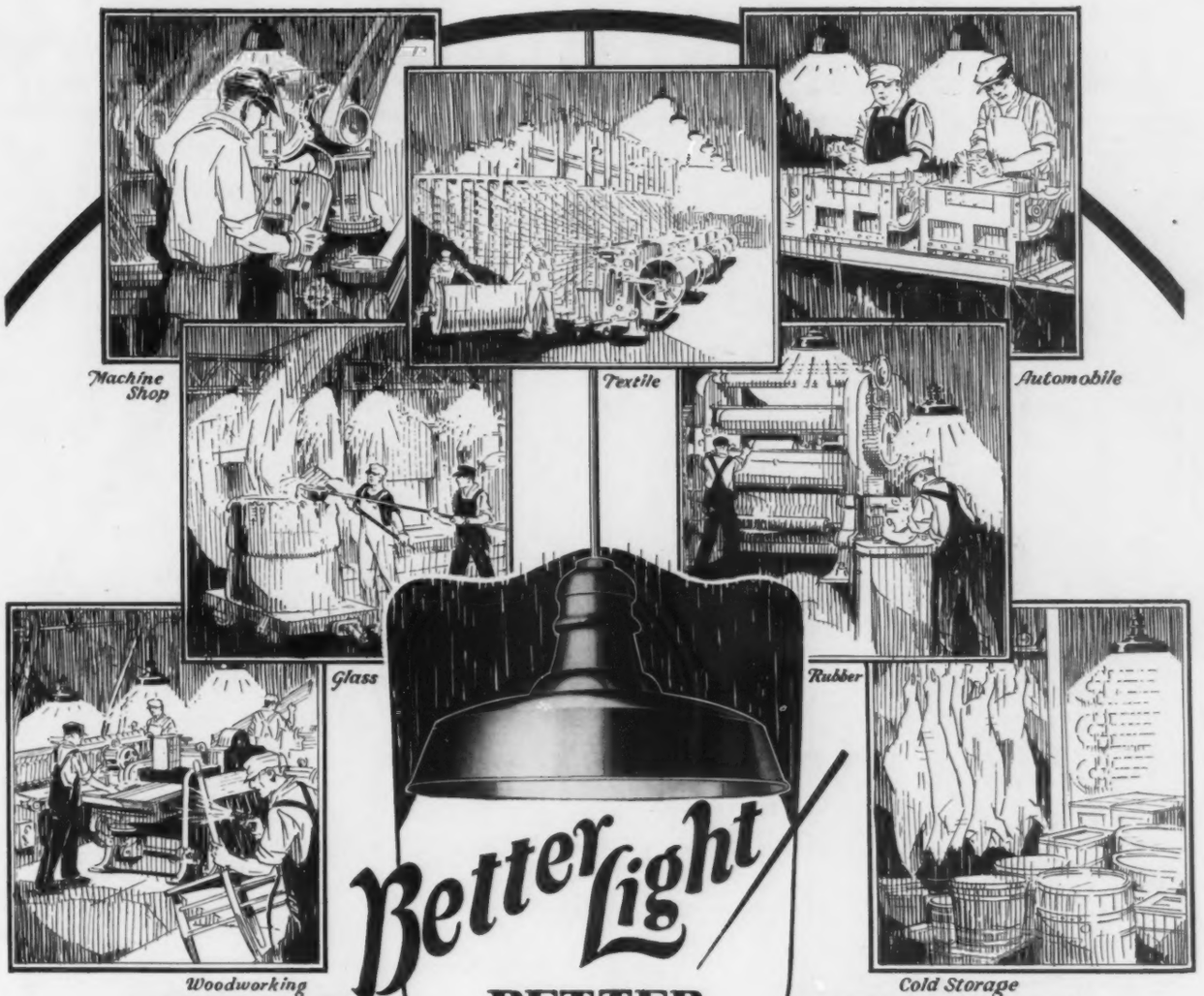
These are questions and problems that Westinghouse Engineers are answering and solving every day.

Westinghouse has a staff of trained illuminating engineers who are at all times ready to assist you. Take advantage of the knowledge of these engineers.

Westinghouse Electric & Manufacturing Company
South Bend Indiana
Sales Offices in All Principal Cities of
the United States and Foreign Countries

W
WESTINGHOUSE ELECTRIC

Westinghouse


Machine Shop
Textile
Automobile
Glass
Rubber
Woodworking
Cold Storage
Railroads
Papermaking
Better Light
BETTER SERVICE
Local stocks of Westinghouse Industrial Lighting Equipment are carried by the following agent jobbers:
Fobes Supply Co., San Francisco, Oakland, Seattle, and Portland
Illinois Electric Co., Los Angeles
Intermountain Electric Co., Salt Lake City
Mine & Smelter Supply Co., Denver, El Paso
Montana Electric Co., Butte, Montana
The Washington Electric Supply Co., Spokane
The Hawaiian Electric Co., Ltd., Honolulu
W
WESTINGHOUSE ELECTRIC
Westinghouse

Porcelain Strain Insulators

For Severest Operating Conditions

Westinghouse Porcelain Strain Insulators are made from the best grade of raw materials, selected to produce high electrical and mechanical properties.

Sharp corners, that would be apt to chip, have been avoided, and the shape of the grooves is such that the cables lie naturally in them. Large creepage distance between the cables is also provided.

PS-type Strain Insulators have a uniformly high mechanical strength that will not puncture under the severest stresses that will be impressed in line service.

Immediate shipment made from complete stocks carried in all our district warehouses.

Westinghouse
Electric & Manufacturing Company
Agent for Westinghouse
High-Voltage Insulator Company
General Office: Derry, Pa.
Works: Derry, Pa.
Emeryville, Calif.

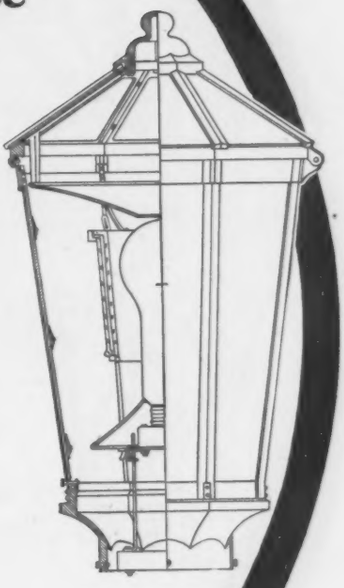
W
WESTINGHOUSE ELECTRIC

Westinghouse

Efficient and Comfortable STREET LIGHTING

W WESTINGHOUSE ELECTRIC

Westinghouse-Holophane Bi-Lux Refractors



Conserve the luminous flux and distribute the light evenly over the street surface where it will produce best results.

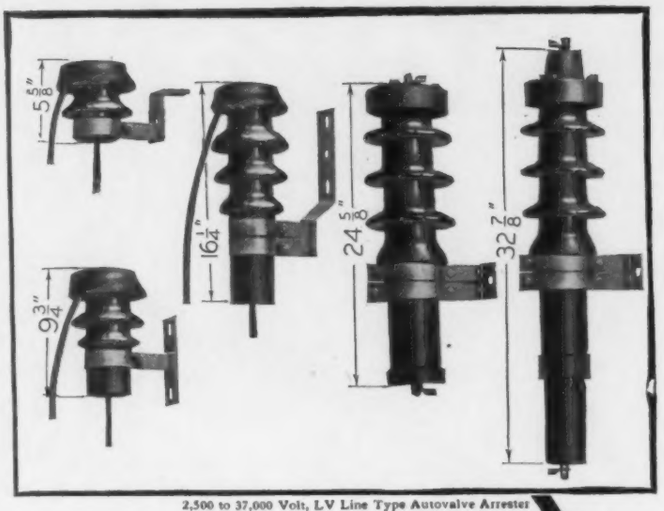
The *Bi-Lux Refractor* can be used either with Westinghouse ornamental post tops or pendants.

WESTINGHOUSE ELECTRIC & MANUFACTURING CO.
GEORGE CUTTER WORKS SOUTH BEND, INDIANA
Sales Offices in All Principal Cities of the United States and Foreign Countries

Westinghouse

A Complete Line Of Valve Type Arresters

25,000 Volt, 3-Phase, Outdoor SV Autovalve Station Arrester



2,500 to 37,000 Volt, LV Line Type Autovalve Arrester

The Autovalve is the first arrester operating on the "Valve Principle" to cover the entire alternating-current field. The SV is a station arrester for the protection of generating stations and substations.

The LV arrester is intended for the protection of distributing transformers. It is made in the sizes illustrated above; 2,500 volt, 7,500 volt, 15,000 volt, 25,000 volt and 37,000 volt. Service tests of these arresters have demonstrated their reliability and effectiveness on commercial distribution systems.

Westinghouse Electric & Manufacturing Co.
East Pittsburgh, Pa.

Butte, 52 East Broadway
Casper, Wyo.
Denver, 910 Fifteenth St.
El Paso, Mills Building
Fresno, Griffith-McKenzie Bldg.
Los Angeles, 420 S. San Pedro St.
Portland, Porter Bldg.
Salt Lake City, So. Temple & W. Temple Sts.
San Francisco, 1 Montgomery St.
Seattle, 3451 E. Marginal Way
Spokane, 821 Old National Bank Bldg.
Tacoma, 615 Rust Bldg.
Tucson, 90 Church St.

WESTINGHOUSE ELECTRIC

Westinghouse

Why *Standard* Electric Ranges Deserve The Name

Standard Ranges set the pace today.

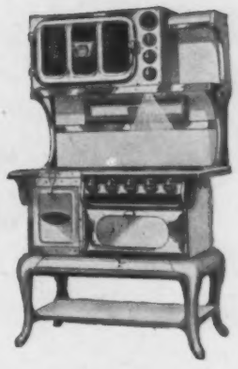
By design, construction and performance Standard Electric Ranges, Cookers, Hot Plates and appliances have established the high standard of efficiency in both the merchandising and the operation of electrical cooking equipment.

Seventeen years of intense specialization by Standard engineers has resulted in a line that brings all the measureless advantages of electrical cooking to the user without trouble, uncertainty or excessive cost.

You can sell Standard Electric Ranges to a wide range of prospects, and always with the comfortable assurance that they will give entire satisfaction under all conditions of use. Service after sale will not touch your profit or your peace of mind.

Do you know that within the last year Standard Electric Ranges have been preferred above all other known makes by the builders of the finest apartment houses and homes in North America? For the most modern ships, hotels and institutions Standard heavy duty equipment has been given the preference after architects and engineers have analyzed all existing competition.

Here is the line you can sell in ever-increasing volume and with ever-increasing satisfaction. Use this coupon and learn more about it.



Model No. 639—$273.00

A popular Standard in white porcelain finish. Other Standard Domestic ranges from $77.50 to $427.00 A wide range in price and design. An absolutely uniform high quality in all.

The Standard Electric Stove Co.
Toledo, Ohio

Standard Electric Ranges

Standard Electric Stove Company,
Division 9,
Toledo, Ohio.
Please send me:
Catalog
Cook Book
I am especially interested in.....
Address .....
Firm Name.....
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Season's Greetings

THE
PACIFIC GAS AND ELECTRIC COMPANY

P·G·and E·

"PACIFIC SERVICE"

Wishes all a
Happy and Prosperous
New Year

PACIFIC GAS AND ELECTRIC COMPANY
PACIFIC COURTEOUS CONTINUOUS SERVICE

41-1224

Here is real protection for electric wiring

Federal Reserve Bank
San Francisco
Electrical Contractors
NePaje, McKinney Co.,
San Francisco

A RIGID CONDUIT that can be "cold bent" right on the job, with a glass-like interior that makes fishing easy. Every length, every elbow and every coupling made safe by **Sherardizing**---an alloying of pure zinc with steel pipe under intense heat---and protected still further by a baked-on coat of acid resisting enamel. Clean, sharp threads, absolutely uniform which save delays on the job.

Sherarduct, the leading condu't makes fine buildings better

National Metal Molding Company

WORLD'S LARGEST PRODUCERS OF ELECTRICAL CONDUITS AND FITTINGS

1523 **Fulton Building, Pittsburgh, Pa.**

Represented in All Principal Cities

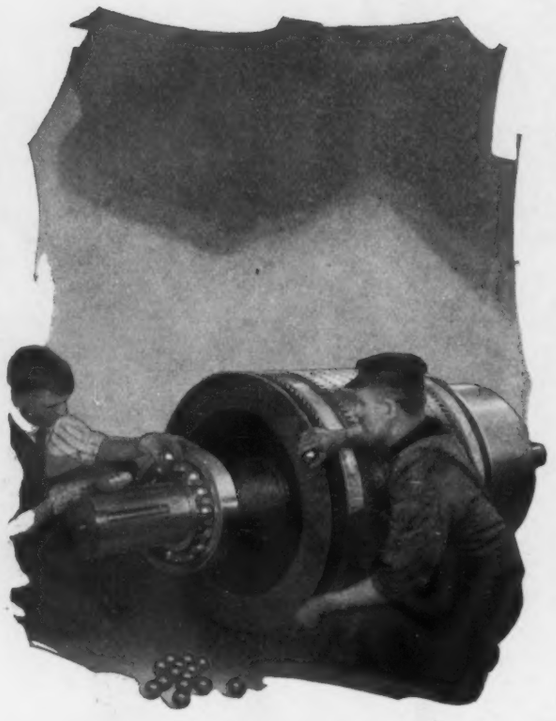
(24)

SHERARDUCT

A NATIONAL METAL MOLDING PRODUCT

The Rigid Conduit That Bends

SKF
Puts the Right Bearing in the Right Place



SKF is linked with a world-wide reputation for delivering satisfactory service, and to an investment too large to be jeopardized by non-performance of anything with which it is connected.

Therefore **SKF** provides a supervision of factories throughout the world and an international organization for scientific research in engineering, manufacturing and merchandising to assure to the user a full measure of performance in products endorsed with the mark **SKF**.

There Are Skayef Self-Aligning Ball Bearings To Fit Every Size Motor

FROM the small fractional horsepower motor to the giant used in steel mills and other heavy service Skayef Self-Aligning Ball Bearings on armatures are a large factor in keeping wheels going without interruptions in production.

Motors run at their initial efficiency as the bearings are practically frictionless and show a minimum of wear in long use. Therefore, correct armature position is maintained indefinitely. Sealed housings prevent lubricant leakage on windings.

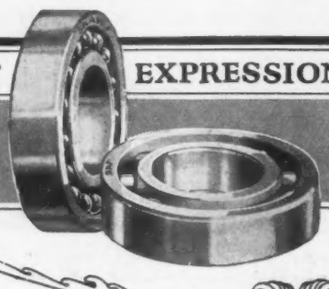
SKF INDUSTRIES OF CALIFORNIA, INC.

115 New Montgomery St.
San Francisco
Phone: Sutter 4196

(A complete Line of Radial and Thrust Ball Bearings Carried in Stock)

1114 South Hope St.
Los Angeles
Phones: 875-365

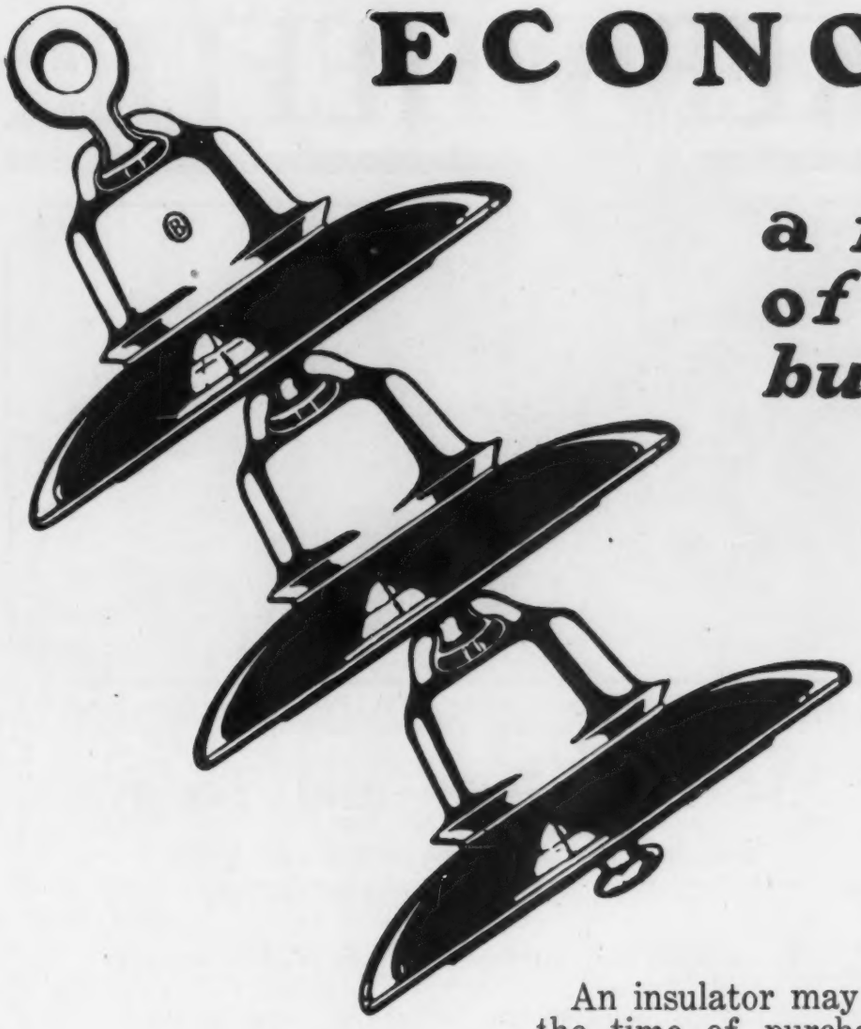
THE HIGHEST EXPRESSION OF THE BEARING PRINCIPLE



BALL BEARINGS

ECONOMY!

Not a matter of price- but YEARS



An insulator may seem expensive at the time of purchase yet show true economy as it piles up years on years of satisfactory service. Length of life is the all-important factor.

Your promise for long life from O-B Insulators is found in the service records they have already made.

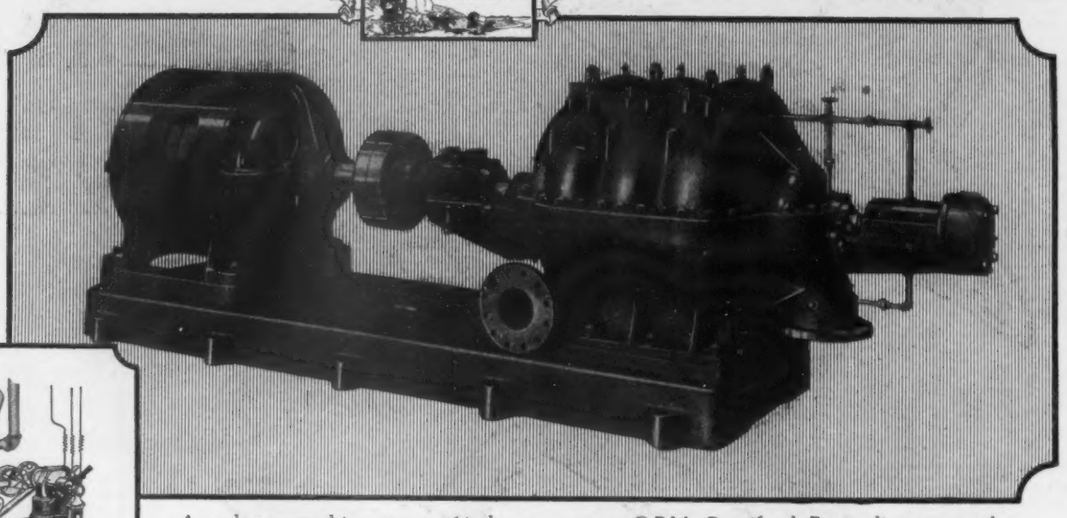
The Ohio Brass Company
Mansfield, Ohio, U.S.A.

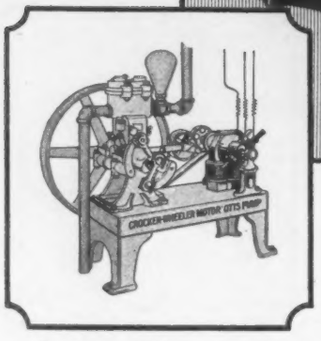
O-B INSULATORS

TIME IS THE TEST

CROCKER-WHEELER

PIONEER MOTOR MANUFACTURERS
Established 1888





The first motor-driven pump—Otis Pump of 1890, belt-connected to Crocker-Wheeler Bipolar Motor.

A modern motor-driven pump—6-inch, 4-stage, 1000 G.P.M. Centrifugal Pump, direct-connected to 200 H.P. Crocker-Wheeler Induction Motor

34 Years Ago—and Today

The first motor-driven pump and today's —both Crocker-Wheeler driven

Down in the black depths of the mine, amidst the mud and silt of the reclamation job, in factory and power plant—in thousands of places—the modern motor-driven pump serves man in many ways.

Electric motor drive for pumps, with its high efficiency and other important advantages, is one of the many motor applications introduced and developed by the Crocker-Wheeler Company. The small insert to the left shows the original motor-driven pump—an old house type Otis Pump of 1890, driven by a Crocker-Wheeler Bipolar Motor.

36 years of incomparable experience are built into Crocker-Wheeler Motors and Generators of today. Made in A.C. and D.C. types, for all requirements.

CROCKER-WHEELER COMPANY, AMPERE, N. J.

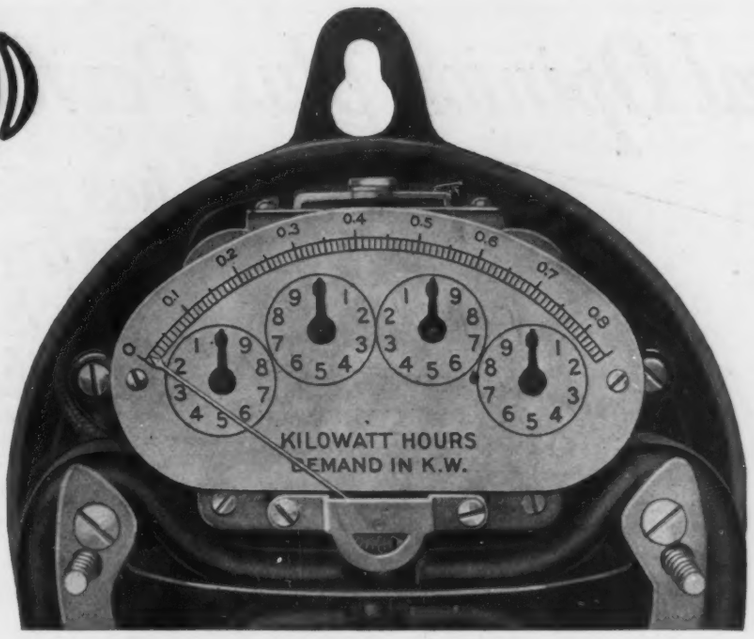
BALTIMORE	BUFFALO	DETROIT	PHILADELPHIA
BIRMINGHAM	CHICAGO	NEW HAVEN	PITTSBURGH
BOSTON	CLEVELAND	NEW YORK	SAN FRANCISCO

Foreign Distributor: International Western Electric Co.

CROCKER-WHEELER COMPANY TRADE MARK

MOTORS & GENERATORS

SANGAMO



Do not estimate maximum demand—*measure it*

It's the cheaper and the only equitable way

ESTIMATING a customer's probable maximum demand is hardly any fairer than estimating his probable monthly energy requirements and doing without watthour meters. Periodic estimates of customers' demands are expensive and inaccurate and do not permit of ready adjustment of rates if a customer's demand increases or decreases. The consumer is seldom satisfied with the rate he gets for he knows that the estimate of his demand is but little better than a mere guess. The only equitable basis for making demand charges is to determine accurately the *actual* maximum demand that has occurred between regular monthly meter readings.

This is exactly what the Sangamo Maximum-demand Register permits you to do. It combines in one unit a watthour register, a demand register and a timing device, indicating on a single dial the energy consumption and the maximum demand that has occurred since the last meter reading and resetting.

A high degree of accuracy is obtained in both energy and demand indications as the result of a number of features of which the following are the most important.

Very little torque is required to advance the demand-indicator hand thus placing practically no additional load on the rotating element of the meter.

Constant time intervals—a most important consideration—are insured through the use of a new tpye of motor which operates at a constant synchronous speed despite voltage, friction and temperature variations.

The use of synchronous motors for this purpose is a Sangamo development.

No slippage or inoperative periods of appreciable length exist as the drive is positive and the pusher arm is reset almost instantaneously through the release of a spring wound up by the synchronous motor.

You can readily obtain the benefits derived from monthly maximum-demand readings as any Sangamo Type-H Watthour Meter may be easily converted into a combined watthour and demand meter by replacing the standard register with the Sangamo Maximum-demand Register. *Write for details.*

Sangamo Electric Company

Springfield, Illinois

6020-1 New York Chicago Birmingham San Francisco Los Angeles

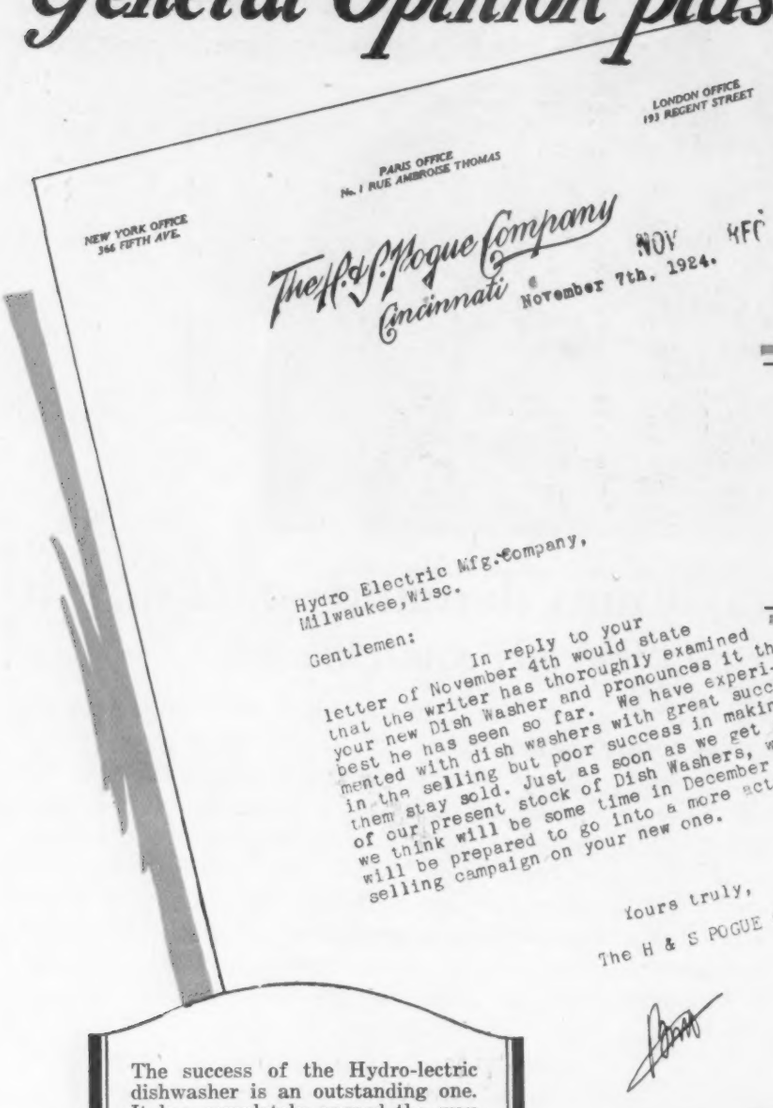
SANGAMO METERS

FOR EVERY ELECTRICAL NEED

General Opinion plus Performance

has placed the Hydro-Lectric Dish washer in the lead!

Central Stations will find in the Hydro-lectric an appliance that will build up sales for their merchandising departments and one that will prove effective in increasing power revenue. Quantity sales result where proper merchandising attention is given to the Hydro-lectric.



NEW YORK OFFICE 366 FIFTH AVE.
PARIS OFFICE No. 1 RUE AMBROISE THOMAS
LONDON OFFICE 193 REGENT STREET

The H. & S. Pogue Company
Cincinnati

NOV 4FF

November 7th, 1924.

Hydro Electric Mfg. Company,
Milwaukee, Wisc.

Gentlemen:

In reply to your letter of November 4th would state that the writer has thoroughly examined your new Dish Washer and pronounces it the best he has seen so far. We have experimented with dish washers with great success in the selling but poor success in making them stay sold. Just as soon as we get rid of our present stock of Dish Washers, which we think will be some time in December we will be prepared to go into a more active selling campaign on your new one.

Yours truly,

The H & S POGUE CO.

The success of the Hydro-lectric dishwasher is an outstanding one. It has completely opened the way to profitable dishwasher sales. The Hydro-lectric has entirely ended "after sale" trouble. Recent extensive sales in Western territory emphasizes the opportunity afforded by this highly developed dishwasher.

There is no special wiring or plumbing necessary—no soaping device to get out of order. One demonstration does the selling.

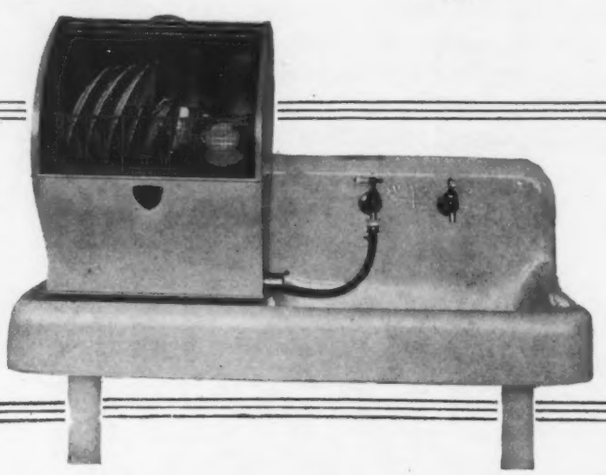
Ask about our merchandising organization.

HYDRO-ELECTRIC MANUFACTURING CO.
Milwaukee, Wisconsin

Western Distributors

A. A. Guilliam
2861 Glendale Blvd. Los Angeles, Calif.

Sloat Wholesale Co.
315 Belmont Street Portland, Oregon



A Complete Line of Motor Starting Switches

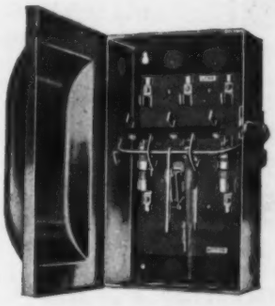
"Circle T" Motor Starting Switches are ruggedly constructed of machine-made parts carefully aligned and subject to rigid factory inspection. In the complete line of types for every service are distinctive "Circle T" features that afford protection to both the operator and the equipment.

The Type 96321 is equipped with overload relays and undervoltage release. The switch is of 60-amp. capacity, large enough for a 10-hp. motor. The relays are non-adjustable, similar in size to an enclosed fuse.

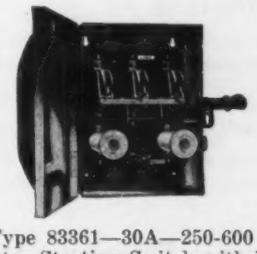
The Type 83361 is equipped with time limit protection plugs and has Snuf-Arcs attached.

The R-M Type is for use with small motors with cartridge fuse protection and is very rugged and small and compact. It has full safety features.

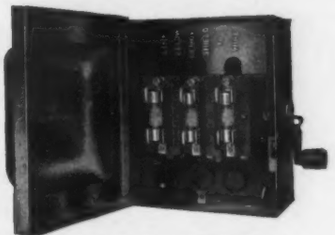
The complete line is shown in Bulletin No. 5



Type 93621 Motor Starting Switch. Undervoltage release. Overload relays.



Type 83361—30A—250-600 v. Motor Starting Switch with Protection Plugs.



R-M Small Size Full Safety Motor Starting Switch

The Trumbull Electric Mfg. Company

595 Mission St., San Francisco, Cal.

Factory and General Offices
PLAINVILLE, CONNECTICUT

Branches in New York, Chicago, Boston, Philadelphia, Atlanta

The home of Special Tower Steel—South San Francisco plant of Pacific Coast Steel Company.

PCS

SPECIAL TOWER STEEL

is the tough, ductile high elastic limit steel developed by Pacific Coast Steel Company. It has an elastic limit of 45,000 lb. and an elongation of 22% and is used for

Transmission Towers
Latticed Poles
Switch Racks—Platforms
Bus Structures
Electric Sign Supports
Radio Towers

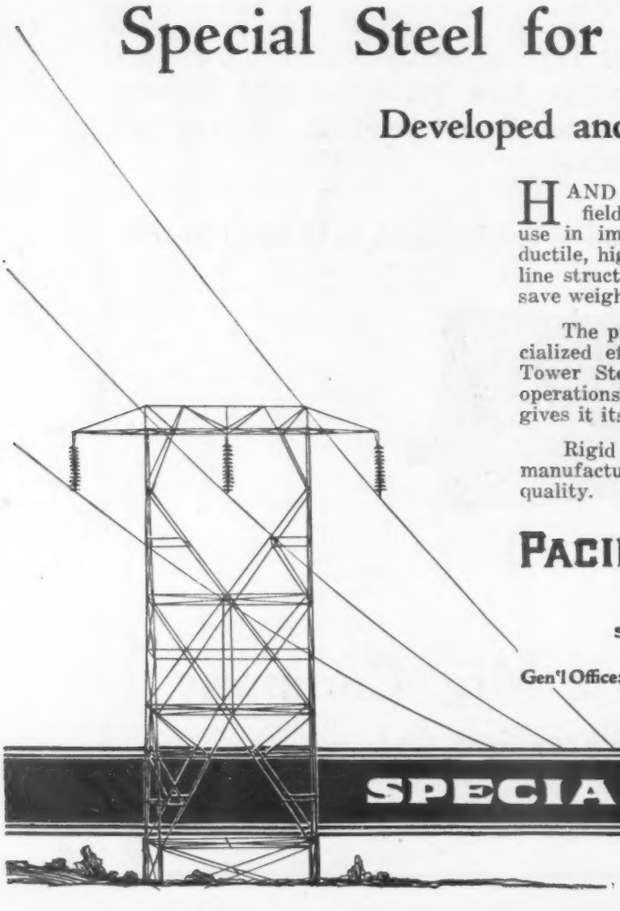
Special Steel for Transmission Towers

Developed and Manufactured on the Pacific Coast

HAND in hand with other achievements in the Transmission Tower field has been the development of Special Tower Steel and its use in important Western transmission line towers. This tough, ductile, high elastic limit steel was created specially for transmission line structures—its primary value lies in the opportunity it offers to save weight without cutting down the safety factor.

The process of manufacture of Special Tower Steel calls for specialized effort and is attended by continual watchfulness. Special Tower Steel passes through the same fundamental manufacturing operations as does ordinary structural steel, but additional treatment gives it its greater strength and better properties.

Rigid tests are made on Special Tower Steel at each stage of the manufacturing and fabricating operations, to keep a check on this quality.



PACIFIC COAST STEEL COMPANY

MANUFACTURERS OF

OPEN HEARTH STEEL

STRUCTURAL SHAPES MERCHANT AND REINFORCING BARS

TRANSMISSION TOWERS AND STRUCTURES

Gen'l Office: Rialto Bldg., San Francisco Plants: San Francisco, Portland, Seattle

SPECIAL TOWER STEEL

Pacific Coast ELECTRICAL SPECIALTY COMPANY Pacific Coast Representatives of Nationally Known Products 1041-9th Ave. So. Seattle 443 S. San Pedro St. Los Angeles 61 Fremont St. San Francisco *Representatives*

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The Material of a Thousand Uses

Moulding Materials
Insulating Varnishes
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Transparent Rods
Transparent Radio Panels

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BARKELEW

Radio Specialties

An established line of fast-selling radio essentials.

Barkelew Four-Phone Posts and Four-Phone Plugs.

Vacuum Tube Lightning Arrestors and Switches

Antenna Ground Switches

Lead-in Insulators

Barkelew Electric Mfg. Co.
Middletown, Ohio

MICANITE

INSULATION

For MOTORS, GENERATORS, and OTHER ELECTRICAL EQUIPMENT

Micanite plate supplied for your own moulding or stamping or made to your specifications as tubes, rods, rings, flanges, spools, bushings, washers, sleeves, and as commutator segments in every size, shape and thickness. Empire Oiled Materials in sheets, tapes, and tubes for a variety of electrical insulations.

Mica Insulator Co.
Factory
Schenectady, N. Y.

Monarch RENEWABLE FUSES

MADE SIMPLE through elimination of loose parts.
ONLY THE BEST MATERIALS—machined under our own supervision.
NO ROLLED THREADS—all threads machine cut for accuracy and strength.
ABSOLUTE STANDARDS with interchangeable parts throughout.
RUGGED CONSTRUCTION to assure long life to all permanent parts.
CORRECT RATING, to guarantee perfect protection.
HIGH EFFICIENCY, which reduces maintenance costs to a minimum.

Approved by National Board of Underwriters

Monarch Refillable Fuse. Co.
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Electrical Specialty Company

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Representatives:

1041-6th Ave So.	61 Fremont St.	443 So. San Pedro St.
Seattle	San Francisco	Los Angeles

Western Progress Number

February 1, 1925

TO present a clear picture of the opportunities presented in the electrical industry in the West for 1925 and give a comprehensive cross-section of the potential market for electrical equipment, appliances and supplies, our editors have selected as the theme for our Feb. 1, Western Progress Number, an analysis of the power company activity for 1924 and an outline of the plans contemplated for 1925.

1. Review of 1924 and Outline of 1925 Proposed Construction Program of the Utilities in the Eleven Western States.
   The article will list the hydroelectric and steam projects completed in 1924, in progress at the present time, or scheduled for 1925. Each project will be briefly discussed, the amount of money involved set down, and the whole article profusely illustrated.
2. Analysis of the Total Connected Load of Western Utilities with Charts of Estimated Growth to 1935.
   Data are being compiled on the total connected load of the Western power companies in the following classifications: Domestic and Commercial Lighting, Agricultural, Railroad, Mining, Industrial and Miscellaneous. Charts will show the growth for the past fifteen years and will be projected into the future. The amount of money to be spent in each of the various classes for electrical equipment will be shown. The installed capacity necessary for serving this load will be noted, as will the kilowatt-hour consumption of energy.

A detailed review of the 1924 construction program will reveal and predetermine the magnitude and extent of the sales activity for 1925. In the West, many large blocks of power have been developed this year or will be ready early in 1925. Sales programs are already outlined for 1925. Merchandising campaigns of large properties are assured.

The analysis of next year's construction program will outline the market possibilities for new apparatus and equipment. With the defeat in the November elections of the so-called Water and Power Act, the power companies of the West are planning very aggressive programs of expansion for 1925.

Supplementing this we will publish the Transmission Line Map of the Eleven Western States, which has been reproduced by the Journal of Electricity every two years. This will be brought up to date and reissued in a size half again as large as in the past. Many important transmission lines have been constructed in the past two years. In addition, the map will show the location of all steam and hydro plants and will give their capacity in kilowatts. Projected generating plants as well as projected transmission lines will also be shown.

The interpretative value of these consolidated statistics will be of interest to every reader. An opportune time for the manufacturer interested in this Western market to present his story will be in combination with this valuable editorial data.

The readers of the Journal are the "Key Men" in the industry. They are the men who either specify the equipment, supervise the construction, control the purchases or sell the output for the Western utilities.

Don't overlook the opportunity of keeping your product before this audience during 1925. The Feb. 1 issue will be worthy of your careful consideration.

Forms close Jan. 25.

Journal of Electricity

Devoted to the Economic Production and Commercial Application of Electricity
IN THE ELEVEN WESTERN STATES

833 MISSION STREET SAN FRANCISCO

DIRECTORY of ENGINEERS

The Journal of Electricity's selected list of Engineers equipped to handle Hydro-Electric and Industrial Development now under way in the West

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ENGINEERING & MANAGEMENT CORPORATION
208 S. La Salle Street, Chicago
New York Tacoma

FORD, BACON & DAVIS
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ENGINEERS
115 Broadway, NEW YORK
Philadelphia Chicago San Francisco

LOUIS F. LEUREY
INDUSTRIAL APPLICATIONS OF ELECTRICITY
58 Sutter St. San Francisco, Cal.

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Consulting Illuminating Engineer
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Telephone Richmond 17 Formerly of Chicago

G. M. GEST
Constructors of Electrical Underground Conduit Systems.
Founded 1896
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DWIGHT P. ROBINSON & CO., Inc.
Design and Construction of Steam Power Stations, Hydro-Electric Developments, Industrial Plants
Union Oil Building, Los Angeles
New York Chicago Youngstown
Philadelphia Montreal Rio de Janeiro
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SANDERSON & PORTER
Established 1896
Design and Construct
Organize, Manage, Operate and Finance
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Engineers—Constructors
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43 Exchange Place New York

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Electrical, Photometrical, Chemical and Mechanical Tests. Inspections of Materials and Apparatus at Manufactory.
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We Built Our Business on Quality

Quality in splicing compound and Quality in friction tape is what every engineer, electrician, electrical contractor, and repairman demands and looks for but doesn't always get. **You can have quality of the absolutely highest grade if you specify and insist on APRUB SPLICING COMPOUND AND FRICTION TAPE and O.K. SPLICING COMPOUND AND BLACK FRICTION TAPE.**

We're in business to serve you with the best.

Buy from Robert P. Tillotson & Co., Los Angeles
C. R. Dederick, Portland
The Electric Material Company,
589 Howard St., San Francisco

APPLETON RUBBER CO.
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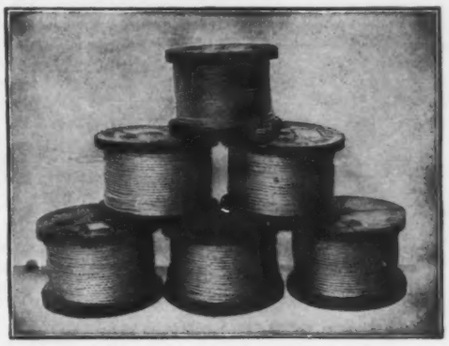
BLACK FRICTION TAPE — TRADE O.K. MARK

"INDIANA"
Galvanized Steel Strand



Standard or Commercial Grade, Single and Double Galvanized.
Siemens-Martin, High Strength and Extra High Strength grades, all Double Galvanized.
2-ply and 3-ply Wire for Special Purposes.

"INDIANA"
Double Galvanized Telephone and Telegraph Wire

We make this wire in three grades—E. B. B. B. B. and Steel.

Indiana Steel & Wire Company
Muncie, - - Indiana

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ALEXANDER & LAVENSON ELECTRICAL SUPPLY CO.

Fada Neutrodyne Radio Sets; Radyne Radio Receivers; Crosley Radio Receivers; Eveready Flashlights and Batteries; Bluebird Electric Clothes Washers; Manning-Bowman Heating Appliances; Square D Switches; Noark Fuses; Bryant Materials; Westinghouse Lamps; Insulating Supplies; Benjamin Industrial Lighting; Hubbell Devices; Magnavox Heaters and Lamps.

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John A. Roebling's Sons Co. of California

San Francisco Los Angeles
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Wire Rope
Blocks and Fittings
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JOBBERS OF
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Distributors for
Royal Electric Cleaners
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Royal Monax Lighting Units
Yale Flashlights

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NEW YORK CHICAGO SEATTLE

FEDERAL ELECTRIC COMPANY

Federal Sirens: What the Navy Thinks of Them
"Federal Sirens of the Norfolk Navy Yard test ran practically twice as long as the only competitor."
"On the question of durability and effectiveness the sirens met all requirements."

Western Factory: Emeryville Station, Oakland, Calif. Sales Offices: 91 New Montgomery St., San Francisco; 529 Electric Bldg., San Diego; 118 East Third Street, Los Angeles; 2718 Elliott Avenue, Seattle, Wash.

SAN FRANCISCO
OAKLAND LOS ANGELES SAN DIEGO

The Montana Electric Co.
Butte, Montana

The Washington Electric Supply Co.
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Distributors for: Anaconda Copper Mining Co.; "A&F" Water Heaters and Covers; Hurley Machine Co.; Crouse-Hinds Co.; Landers, Frary & Clark; Chicago Insulated Wire & Mfg. Co.; W. N. Matthews; Bryant Electric Co.; Radio Corporation of America. Westinghouse Electric & Mfg. Co.; Westinghouse Lamp Co.; R. Williamson & Co.

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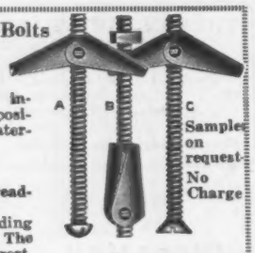
Jobbers and Distributors
— of —
WIRING MATERIALS
APPLIANCES
GLASSWARE and FIXTURES
RADIO SUPPLIES

224-228 East Third St.,
Los Angeles, Calif.

Paine Toggle Bolts



The only spring type toggle on the market. The wings will open instantly in any position in hollow material.
Any style head.
Any length bolt.
Standard bolts threaded to head.
Requires no guiding — just insert — The spring does the rest.

Samples on request—No Charge

The Paine Company, Chicago, Ill.

Stock Carried: J. J. Noble, 952 Folsom St, San Francisco, Calif. Rep., J. J. Schaller, 257 Spring St., Los Angeles, Calif.

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Master
Greyhound
Laundrola
Dolly—wood and copper

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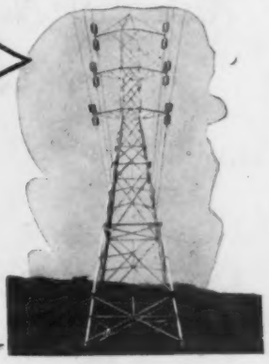

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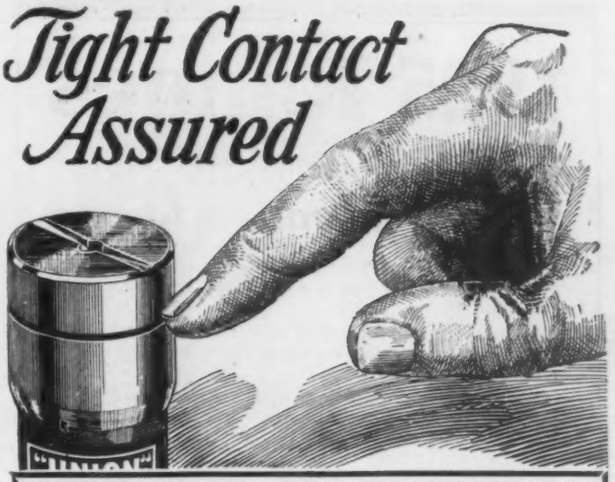

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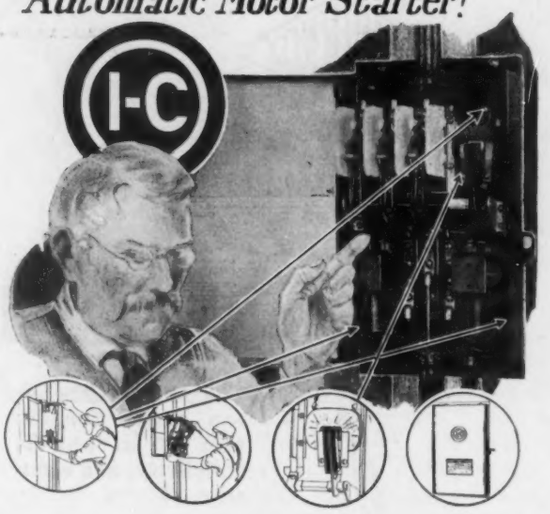

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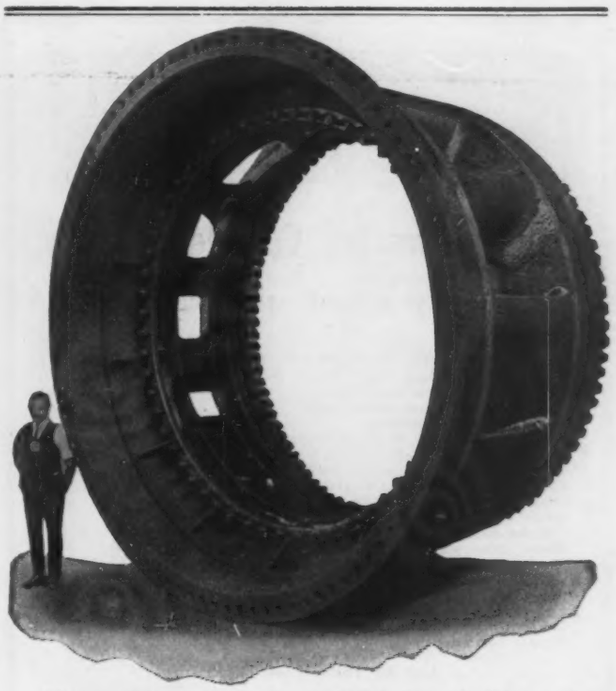

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Moore & Company, Chas. C.
Westinghouse Electric & Mfg. Co.

Fans, Portable, Ceiling
Emerson Electric Mfg. Co.
General Electric Company
Pacific States Electric Company
Western Electric Company
Westinghouse Electric & Mfg. Co.

Fans, Exhaust
Allis-Chalmers Mfg. Company
General Electric Company
Pacific States Electric Company
Western Electric Company
Westinghouse Electric & Mfg. Co.

Fault Finders, Electric
Electric Controller & Mfg. Co.
Westinghouse Electric & Mfg. Co.

Fibre
Clapp & LaMoree
Continental Fibre Co., The
Johns-Manville, Inc.
Pacific States Electric Company
Westinghouse Electric & Mfg. Co.

Fixtures, Fixture Parts
Benjamin Electric Mfg. Co.
Bryant Electric Company, The
Curtis Lighting, Inc.
Harvey Hubbell, Inc.
McGill Mfg. Co.
Myers Electric Supply Co.
National Metal Molding Co.
Pacific States Electric Company
Pass & Seymour
Sherman Mfg. Company, H. B.
Western Electric Company

Flash Lights, Electric
Pacific States Electric Company
Trumbull Electric Mfg. Co.
Western Electric Company

Flood Light Projectors
Curtis Lighting, Inc.
General Electric Company
Westinghouse Electric & Mfg. Co.

Furnaces, Electric
Hagan Co., Geo. J.
Detroit Elect. Furnace Co.

Fuses and Fuse Specialties
Baker-Joslyn Company
Chicago Fuse Mfg. Co.
D & W Fuse Works of G. E. Co.
Electrical Specialty Co., Inc.
Federal Electric Company
Johns-Pratt Company, The
Line Material Co.
Metropolitan Electric Mfg. Co.
Monarch Fuse Co.
Pacific States Electric Company
Western Electric Company
Westinghouse Electric & Mfg. Co.

Governors
Allis-Chalmers Mfg. Company
General Electric Company
Pelton Water Wheel Co.

Ground Clamps
Sherman Mfg. Co.

Guards, Lamp
Benjamin Electric Mfg. Co.
Harvey Hubbell, Inc.
McGill Manufacturing Co.
Pacific States Electric Company
Western Electric Company

Hangers, Lamp, Fixture, Cable
Baker-Joslyn Company
Hubbard & Company
Ohio Brass Company, The
Pacific States Electric Company
Standard Underground Cable Co.
Western Electric Company
Westinghouse Electric & Mfg. Co.

Headlights, Electric
General Electric Company
Westinghouse Electric & Mfg. Co.

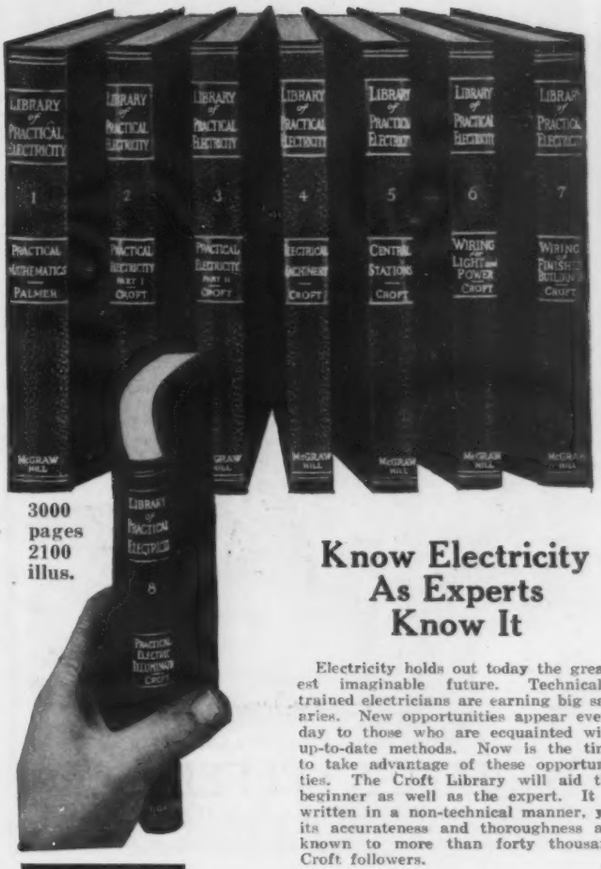
Heaters, Air
Hicks, W. Wesley

Heating Elements
Hagan Co., Geo. J.
Wiegand Co., Edwin L.

Heating Equipment, Electric
Hagan Co., Geo. J.

Heating Appliances, Domestic
Edison Electric Appliance Co.
General Electric Company
Hicks, W. Wesley
Lindermann & Hoverson Co., A..J
Magee Furnace Co.
Magnavox Company
Majestic Electric Appliance Co.
Pacific States Electric Company
Reiman Wholesale Elec. Co.
Russell Electric Co.
Simplex Electric Heating Co.
Standard Electric Stove Co.
Western Electric Company
Westinghouse Electric & Mfg. Co.

For a cross-indexed list of manufacturers and their Western Representatives, published annually, see issue of Oct. 15, 1924 for last edition.



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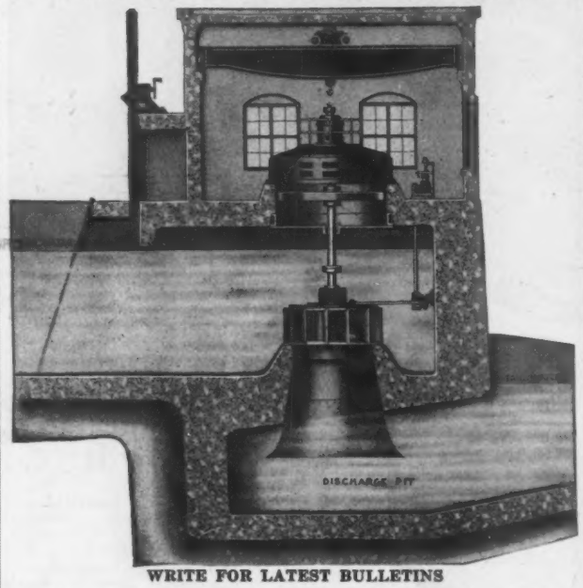

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"OK" Weatherproof Wire

"Parac" Rubber Wire

Slow Burning Wire

Bare Copper Wire

PHILLIPS WIRE COMPANY

Pawtucket, R. I.

WHERE TO BUY

CLASSIFIED INDEX TO ADVERTISERS

Hoists, Air Motor
Ingersoll-Rand Co.

Hoists, Electric
General Electric Company
Link-Belt Meese & Gottfried Co.
Moore & Company, Chas. C.

Hoods, Street
Benjamin Electric Mfg. Co.
Pacific States Electric Company
Western Electric Company
Westinghouse Electric & Mfg. Co.

Industrial Signals
Benjamin Electric Mfg. Co.

Instruments, Recording, Testing
Jewell Elec. Instrument Co.
Pacific States Electric Company
Roller-Smith Company
Sangamo Electric Co.
Western Electric Company

Insulation, Boiler and Pipe
Johns-Manville, Inc.

Insulations, Moulded
Johns-Manville, Inc.

Insulators
Baker-Joslyn Company
Champion Switch Co.
General Electric Company
Hemingray Glass Co.
Jeffery-Dewitt Insulator Co.
Lapp Insulator Co., The
Locke Insulator Corp.
Maydwell & Hartzell, Inc.
Ohio Brass Company, The
Pacific States Electric Company
Thomas & Sons Company, The R.
Western Electric Company
Westinghouse Electric & Mfg. Co.

Insulating Material
Bakelite Corporation
Baker-Joslyn Company
Clapp & LaMoree
Delta-Star Electric Co.
Electrical Specialty Co., Inc.
General Electric Company
Irvington Varnish & Insulator Co.
Johns-Manville, Inc.
Mica Insulator Company
Pacific States Electric Company
Standard Underground Cable Co.
Westinghouse Electric & Mfg. Co.

Lamp Frostings
McKay Company

Lamp Replacer
G. C. A. Mfg. Co., The

Lamps, Incandescent
Edison Lamp Works of G. E. Co.
Mazda Service of G. E. Co.
National Lamp Works
Pacific States Electric Company
Reiman Wholesale Elec. Co.
Western Electric Company
Westinghouse Lamp Company

Lamps, Smokers'
Lees Co., K. F.

Lamp Standards
Pacific States Electric Company
Western Electric Company
Westinghouse Electric & Mfg. Co.

Line Material, Pole, Railway
Baker-Joslyn Company
General Electric Company
Hubbard & Company
Line Material Co.
Locke Insulator Corp.
Maydwell & Hartzell, Inc.
Ohio Brass Company, The
Pacific States Electric Company
Thomas & Sons Company, The R.
Western Electric Company
Westinghouse Electric & Mfg. Co.

Loading Machinery, Portable
Link-Belt Meese & Gottfried Co.

Locknuts and Bushings
Baker-Joslyn Company
National Metal Molding Co.
Pacific States Electric Company

Locomotive Cranes, Steam, Electric
Link-Belt Meese & Gottfried Co.

Machinery, Mining
Allis-Chalmers Mfg. Co.
General Electric Company
Link-Belt Meese & Gottfried Co.

Magnets, Lifting
Electric Controller & Mfg. Co.
Ohio Electric & Controller Co.

Marine Lighting and Signalling Apparatus
Benjamin Electric Mfg. Co.
General Electric Company
Westinghouse Electric & Mfg. Co.

Meters
Duncan Electric Mfg. Co.
General Electric Company
Jewell Elec. Instrument Co.
Roller-Smith Company
Sangamo Electric Co.
Sewickley Electric Mfg. Co.
Western Electric Company
Westinghouse Electric & Mfg. Co.

Meter Testers
Johns-Pratt Company, The

Molding, Metal, Wood
American Wiremold Co.
National Metal Molding Co.
Pacific States Electric Company
Western Electric Company

Motors, A.C., D.C.
Allis-Chalmers Mfg. Company
Champion Electric Co.
Crocker-Wheeler Co.
Electric Controller & Mfg. Co.
Fairbanks, Morse & Co.
General Electric Company
Ohio Electric & Controller Co.
Wagner Electric Corporation
Western Electric Company
Westinghouse Electric & Mfg. Co.

Motor Generators
Crocker-Wheeler Co.
General Electric Company
Wagner Electric Corporation
Western Electric Company
Westinghouse Electric & Mfg. Co.

Motor Starters
Condit Electrical Mfg. Co.
Electric Controller & Mfg. Co.
General Electric Company
Industrial Controller Co.
Pacific States Electric Company
Trumbull Electric Mfg. Co.
Wagner Electric Corporation
Western Electric Company
Westinghouse Electric & Mfg. Co.

Oil Burners & Systems
Moore & Company, Chas. C.

Oil Separators
De Laval Separator Co., The

Outlet Boxes and Covers
Chicago Fuse Mfg. Company
National Metal Molding Co.

Packings, Asbestos
Johns-Manville, Inc.

Paint, Insulating
Bakelite Corporation
Baker-Joslyn Company
Electrical Specialty Co., Inc.
Pacific States Electric Company
Westinghouse Electric & Mfg. Co.

Panel Boards, Panels
Benjamin Electric Mfg. Co.
Bryant Electric Company, The
Chicago Fuse Mfg. Co.
General Electric Company
Pacific States Electric Company
Western Electric Company
Westinghouse Electric & Mfg. Co.

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WHERE TO BUY

CLASSIFIED INDEX TO ADVERTISERS

Pins, Wood, Iron, Steel
Baker-Joslyn Company
Hubbard & Company
Line Material Company
Locke Insulator Corp.
Maydwell & Hartzell, Inc.
Pacific States Electric Company
Thomas & Sons Company, The R.
Western Electric Company
Westinghouse Electric & Mfg. Co.

Pipe, Pressure
Kellogg Company, The M. W.
National Tube Co.

Plates, Flush Switch
Pacific States Electric Company
Western Electric Company

Pliers, Insulated
Bard-Parker Co., Inc.

Plugs, Receptacles, Sockets
Ajax Electric Specialty Co.
Arrow Electric Co., The
Barkelew Electric Mfg. Co.
Benjamin Electric Mfg. Co.
Bryant Electric Co.
Connecticut Elec. Mfg. Co.
Curtis Lighting, Inc.
Electrical Specialty Co., Inc.
Esler Electric Mfg. Co.
Hart & Hegeman Mfg. Co.
Harvey Hubbell, Inc.
McGill Manufacturing Co.
Pacific States Electric Company
Pass & Seymour
Western Electric Company

Poles, Iron, Steel, Wood
Baker-Joslyn Company
Bates Expanded Steel Truss Co.
Maydwell & Hartzell, Inc.
Pacific Coast Steel Co.
Pacific States Electric Company
Western Electric Company
Weyerhaeuser Forest Products Co.

Pole Jacks
Templeton, Kenly & Co. Ltd.

Porcelain Specialties
Baker-Joslyn Company
Locke Insulator Corp.
Maydwell & Hartzell, Inc.
Pacific States Electric Company
Thomas & Sons Company, The R.
Western Electric Company

Potheads
G & W Electric Specialty Co.
Standard Underground Cable Co.
Westinghouse Electric & Mfg. Co.

Power Plants
Allis-Chalmers Mfg. Company
General Electric Company
Moore & Company, Chas. C.
Westinghouse Electric & Mfg. Co.

Power Transmission, Mechanical
Link-Belt Meese & Gottfried Co.

Printing
Neal, Stratford & Kerr

Projectors, Electric
Curtis Lighting, Inc.
General Electric Company
Westinghouse Electric & Mfg. Co.

Protective Devices
Condit Electrical Mfg. Co.
Roller-Smith Company

Pulleys
Rockwood Mfg. Co., The

Pumps
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works)
Moore & Company, Chas. C.
Pelton Water Wheel Co.
Westinghouse Electric & Mfg. Co.
Worthington Pump & Machy.Corp.

Push Buttons
Benjamin Electric Mfg. Co.
Bryant Electric Company, The
Electric Controller & Mfg. Co.
Harvey Hubbell, Inc.
Pacific States Electric Company
Western Electric Company

Radiators, Electric
Reiman Wholesale Electric Co.
Simplex Electric Heating Co.

Radio Apparatus
Electric Appliance Co.
Fobes Supply Co.
Illinois Electric Co.
Lee Electric & Mfg. Co.
Montana Electric Co.
Myers Electric Supply Co.
Pacific States Electric Co.
Washington Electric Supply Co.
Wholesale Electric Co.

Rail Bonds
General Electric Company
Ohio Brass Company, The
Western Electric Company
Westinghouse Electric & Mfg. Co.

Rectifiers
General Electric Company
Pacific States Electric Company
Wagner Electric Corporation
Western Electric Company
Westinghouse Electric & Mfg. Co.

Reflectors
Benjamin Electric Mfg. Co.
Curtis Lighting, Inc.
Harvey Hubbell, Inc.
Pacific States Electric Company
Western Electric Company
Westinghouse Electric & Mfg. Co.

Regulators, Voltage
General Electric Company
Western Electric Company
Westinghouse Electric & Mfg. Co.

Reinforcing Bars
Pacific Coast Steel Co.

Relays
Condit Electrical Mfg. Co.
Electric Controller & Mfg. Co.
General Electric Company
Westinghouse Electric & Mfg. Co.

Resistances
Electric Controller & Mfg. Co.
General Electric Company
Western Electric Company
Westinghouse Electric & Mfg. Co.

Rheostats
Electric Controller & Mfg. Co.
General Electric Company
Pacific States Electric Company
Western Electric Company
Westinghouse Electric & Mfg. Co.

Roofing and Siding, Asbestos
Johns-Manville, Inc.

Rosettes
Arrow Electric Co., The
Bryant Electric Company, The
General Electric Company
Harvey Hubbell, Inc.
Pass & Seymour

Screens, Rock
Link-Belt Meese & Gottfried Co.

Screens, Water Intake
Link-Belt Meese & Gottfried Co.

Searchlights
General Electric Company
Pacific States Electric Company

Silent Chain Drive
Link-Belt Meese & Gottfried Co.

Sockets, Pull
Arrow Electric Co., The
Bryant Electric Company, The
Harvey Hubbell, Inc.

Solder, Self-fluxing, Solid Wire and Bar
Baker-Joslyn Company
Pacific States Electric Company
Western Electric Company
Westinghouse Electric & Mfg. Co.

Solenoids
Electric Controller & Mfg. Co.
Westinghouse Electric & Mfg. Co.

Stationery
Neal, Stratford & Kerr

Steam Piping
Pittsburgh Piping & Equipt. Co.

Steel, Structural & Reinforcing
Pacific Coast Steel Co.

Street Lighting
General Electric Company
Line Material Co.
Pacific States Electric Company
Western Electric Company
Westinghouse Electric & Mfg. Co.

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Red Stripe

THE possibilities of Dilecto are without end in the electrical field. It possesses every needed qualification for equipment or appliance insulation.

Always uniform and dependable. Replaces to advantage fittings of wood, rubber, leather, porcelain, mica, glass and metals.

Electrical men not thoroughly familiar with Dilecto advantages will be interested in "Insulation"—it contains many important facts about Dilecto, Continental-Dilecto, Continental-Bakelite, Conite and Continental Vulcanizing Fibre. Consult with a Continental engineer—he can help you!

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SIMPLEX WIRE & CABLE Co

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"Diamond" Branch BUFFALO, N. Y.

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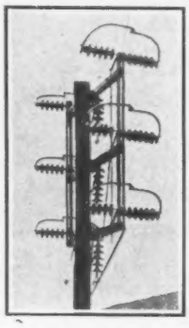
Okonite is made in but one grade.

THE OKONITE CO., Passaic, N. J.

PACIFIC COAST OFFICES
754 Monadnock Building, San Francisco, Calif.



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Pacific Coast Department
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LOS ANGELES SEATTLE SALT LAKE CITY
FACTORY AT EMERYVILLE, CALIF.

WHERE TO BUY

CLASSIFIED INDEX TO ADVERTISERS

Sub-Stations
Delta-Star Electric Co.
Westinghouse Electric & Mfg. Co.

Subway Boxes
Johns-Pratt Company, The

Switchboards
Allis-Chalmers Mfg. Co.
Baker-Joslyn Company
Condit Electrical Mfg. Co.
Elec. Power Equipment Corp.
General Electric Company
Johns-Manville, Inc.
Pacific States Electric Company
Trumbull Electric Mfg. Co.
Western Electric Company
Westinghouse Electric & Mfg. Co.

Switches, Automatic Time
Anderson Mfg. Co., Albert & J. M.

Switches, High Tension
Allis-Chalmers Mfg. Company
Champion Switch Company
Condit Electrical Mfg. Co.
Delta-Star Electric Co.
Elec. Power Equipment Corp.
General Electric Company
K-P-F Electric Co.
Pacific Electric Mfg. Co.
Trumbull-Vanderpoel Elec. Mfg. Co.
Westinghouse Electric & Mfg. Co.

Switches, House Service
Arrow Electric Co., The
Baker-Joslyn Company
Benjamin Electric Mfg. Co.
Bryant Electric Company, The
Condit Electrical Mfg. Co.
Connecticut Elec. Mfg. Co.
Elec. Power Equipment Corp.
General Electric Company
Harvey Hubbell, Inc.
Pacific States Electric Company
Reiman Wholesale Elec. Co.
Trumbull-Vanderpoel Elec. Mfg. Co.
Western Electric Company
Westinghouse Electric & Mfg. Co.

Switches, Motor Controlling
Barkelew Electric Mfg. Co.
Bryant Electric Company, The
Condit Electrical Mfg. Co.
Electric Controller & Mfg. Co.
Electric Power Equipment Corp.
Electrical Specialty Co., Inc.
General Electric Company
Industrial Controller Co.
Johns-Pratt Company, The
Pacific States Electric Company
Square D Company
Trumbull Electric Mfg. Co.
Trumbull-Vanderpoel Elec. Mfg. Co.
Western Electric Company
Westinghouse Electric & Mfg. Co.

Tape, Friction, Rubber
Anchor Webbing Co.
Appleton Rubber Co.
Baker-Joslyn Co.
Boston Woven Hose & Rubber Co.
Clifton Mfg. Co.
Electrical Specialty Co., Inc.
General Electric Company
Johns-Manville, Inc.
Mica Insulator Company
New York Insulated Wire Co.
Okonite Company, The
Pacific States Electric Company
Western Electric Company
Westinghouse Electric & Mfg. Co.

Telephone Equipment
Pacific States Electric Company
Western Electric Company

Time Clocks
Tork Company

Tools, Linemen and Construction
Baker-Joslyn Company
Buhrke Co., R. H.
Hubbard & Company
Leach Company
Maydwell & Hartzell, Inc.
Pacific States Electric Company
Western Electric Company

Towers, Steel
Bates Expanded Steel Truss Co.
Blaw-Knox Company
Pacific Coast Steel Co.

Toys, Electric
Lionel Corp., The

Transformers
Allis-Chalmers Mfg. Company
Duncan Electric Mfg. Co.
General Electric Company
Pacific States Electric Company
Packard Electric Co., The
Wagner Electric Corporation
Western Electric Company
Westinghouse Electric & Mfg. Co.

Traps, Steam
Johns-Manville, Inc.

Trolley Line Material
Baker-Joslyn Company
General Electric Company
Ohio Brass Company, The
Pacific States Electric Company
Western Electric Company
Westinghouse Electric & Mfg. Co.

Turbines, Hydraulic, Water Wheels
Allis-Chalmers Mfg. Company
Cramp & Sons Co., The Wm.
Joshua Hendy Iron Works
Leffel & Co., The James
Pelton Water Wheel Co.
Smith Company, S. Morgan
Worthington Pump & Machy. Corp.

Turbines, Steam
Allis-Chalmers Mfg. Company
General Electric Company
Westinghouse Electric & Mfg. Co.

Underfloor Duct
Johns-Manville, Inc.

Water Heaters
Hicks, W. Wesley

Water Wheel Governors
Woodward Governor Co.

Welding Apparatus, Electric
General Electric Company
Ohio Brass Company, The
Pacific States Electric Company
Western Electric Company

Windings
Dudlo Manufacturing Co.

Wire, Bare and Insulated Copper
American Brass Co., The
Anaconda Copper Mining Co.
Baker-Joslyn Company
California Wire & Cable Co.
Collyer Insulated Wire Co.
Dudlo Manufacturing Co.
Electric Appliance Co.
Indiana Rubber & Insul. Wire Co.
Indiana Steel & Wire Co.
Maydwell & Hartzell, Inc.
National Metal Molding Co.
New York Insulated Wire Co.
Okonite Company, The
Pacific States Electric Company
Peerless Ins. Wire & Cable Co.
Phillips Wire Co.
Reiman Wholesale Elec. Co.
Rockbestos Products Corp.
Roebling's Sons Co.
Rome Wire Co.
Simplex Wire & Cable Co.
Standard Underground Cable Co.
Western Electric Company

Wire, Electric Resistance
Driver-Harris Company

Wire, Galvanized Steel
American Copper Products Corp.
Baker-Joslyn Company
Maydwell & Hartzell, Inc.
Pacific States Electric Company
Phillips Wire Co.
Rockbestos Products Corp.
Roebling's Sons Co., John A.
Rome Wire Co.
Simplex Wire & Cable Co.
Standard Underground Cable Co.
Western Electric Company.

Wiring Devices
Arrow Electric Co., The
Bryant Electric Company, The
Connecticut Elec. Mfg. Co.
Harvey Hubbell, Inc.
Pacific States Electric Company

Wiring Specialties
Electric Equipt. & Mfg. Co.

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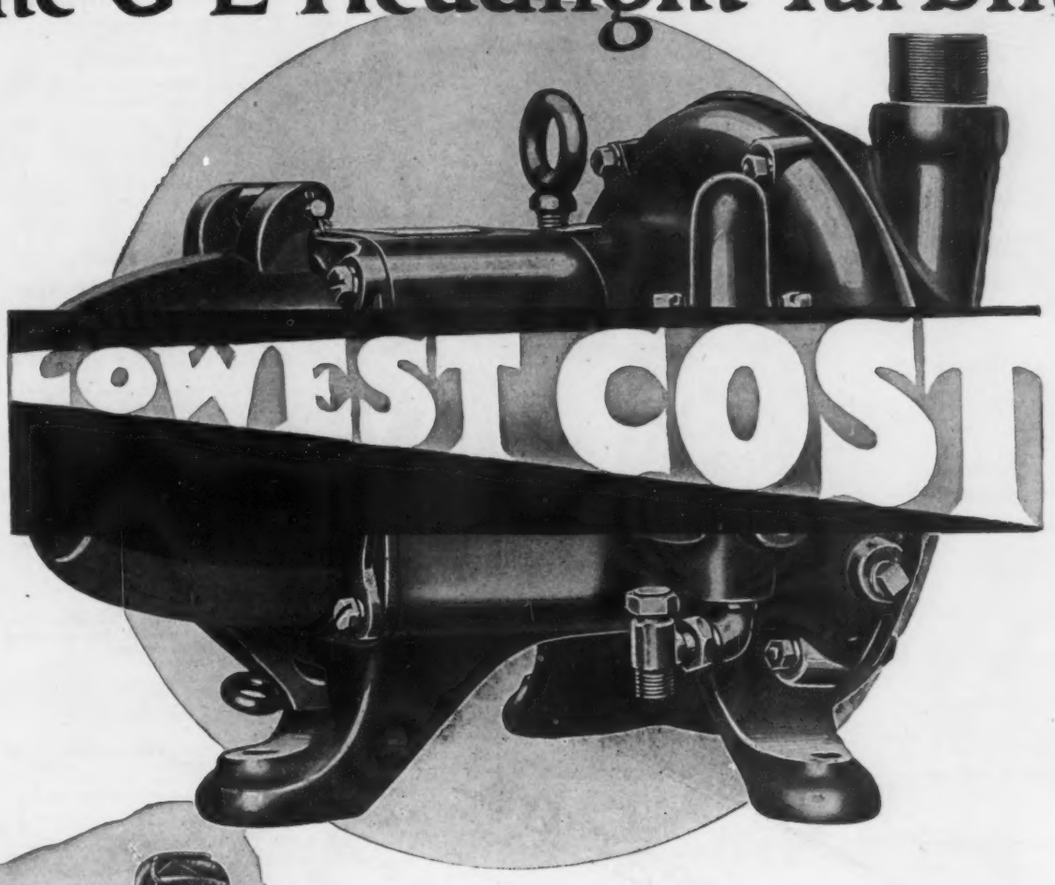
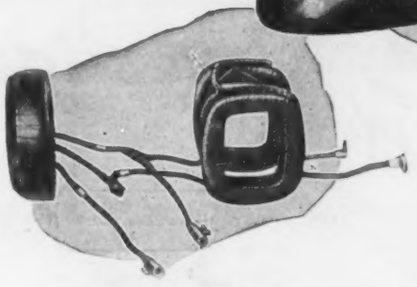
The G-E Headlight Turbine





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Their Best Train Delayed!

That happened recently on a leading railroad which uses one of the "less expensive" headlight turbines. The generator was supplying 45 volts. Headlight lamps might stand 50% over-voltage for three hours, but not at 60 miles an hour.

Contrast this condition with the fact that it is practically impossible for the G-E Headlight Turbine to over-speed.

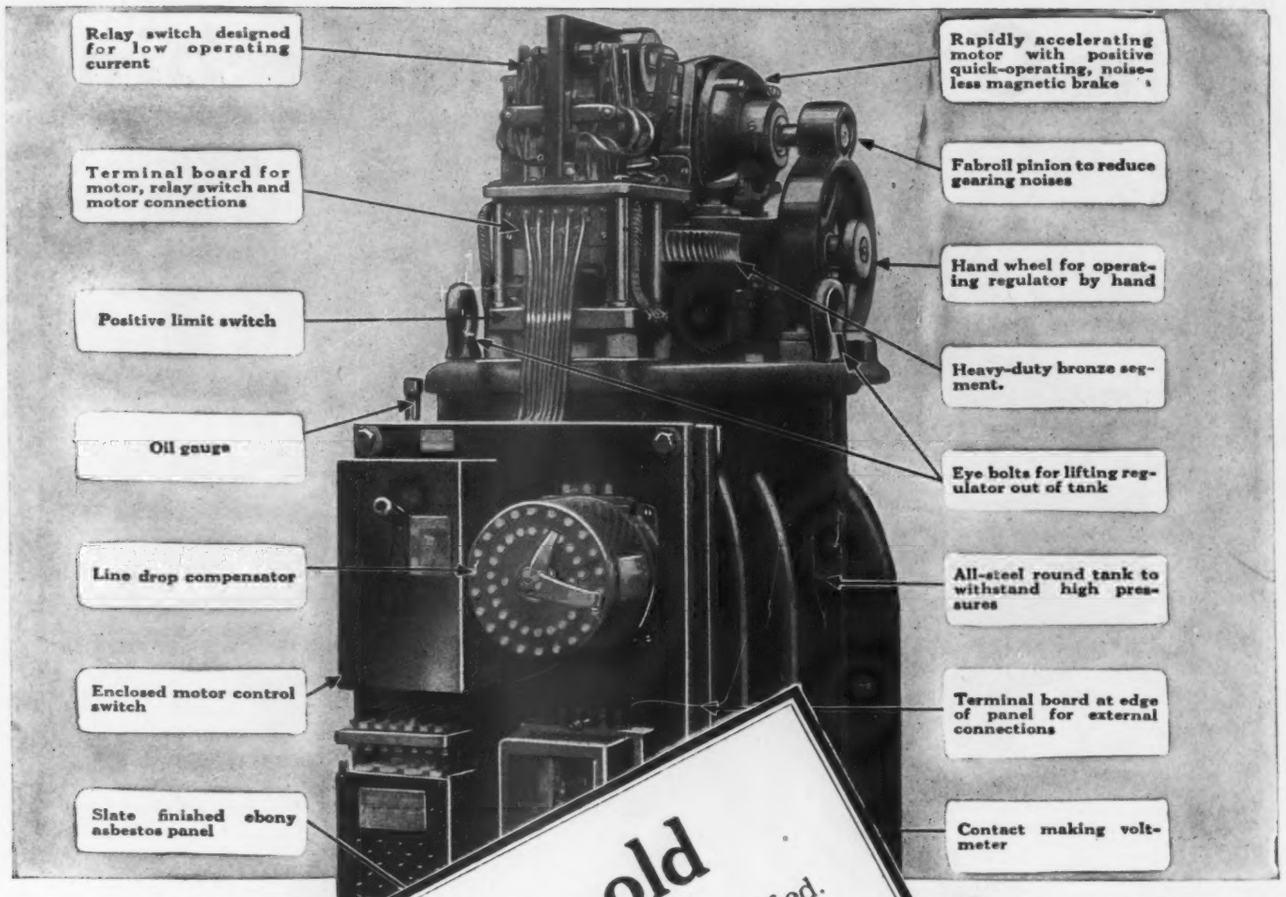
The G-E Set employs a constant-pressure, constant-load governing principle — very simple, but very positive. A reducing valve maintains constant steam pressure at the nozzle regardless of boiler pressure; a magnetic brake coil maintains constant load on the wheel independent of lamp load.

It's not surprising, therefore, that on roads using G-E Headlight Turbines, lamp failures, and consequent locomotive detentions, are practically unknown. Incidentally, this magnetic governor, simply a stationary coil, has nothing about it to wear — another big saving.

A governing mechanism which is unique is one of the reasons for the superior operation of G-E Headlight Turbines. This whole subject is presented in a new booklet. For copy address Railway Department, General Electric Company, Schenectady, N. Y.

54-1

GENERAL ELECTRIC


Relay switch designed for low operating current
Terminal board for motor, relay switch and motor connections
Positive limit switch
Oil gauge
Line drop compensator
Enclosed motor control switch
Slate finished ebony asbestos panel
Panel supports
Rapidly accelerating motor with positive quick-operating, noiseless magnetic brake
Fabroil pinion to reduce gearing noises
Hand wheel for operating regulator by hand
Heavy-duty bronze segment.
Eye bolts for lifting regulator out of tank
All-steel round tank to withstand high pressures
Terminal board at edge of panel for external connections
Contact making voltmeter
Straps for panel supports
Flanged steel base
Oil drain at extreme bottom of tank

One year old

And our claims have now been verified. Operating companies from coast to coast have proved for themselves that this new G-E Regulator offers advantages equalled by no other regulator.

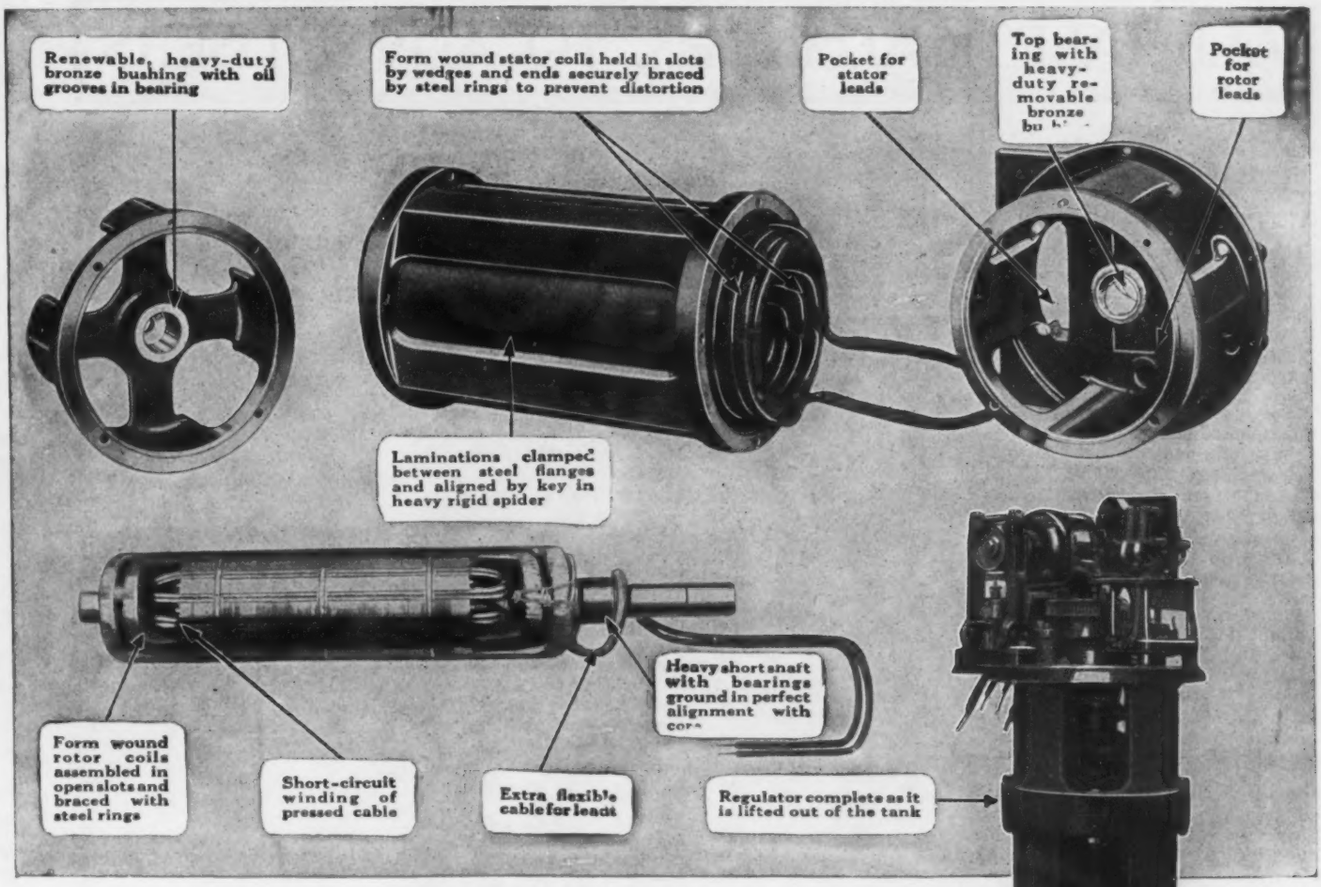
These regulators are available for inspection and test.

Investigate

Bulletin 45450-A describes both this new Induction Regulator and G-E Automatic Generator Voltage Regulators. Your copy sent on request.

23 to 115 kv-a.

GENERAL


Renewable, heavy-duty bronze bushing with oil grooves in bearing
Form wound stator coils held in slots by wedges and ends securely braced by steel rings to prevent distortion
Pocket for stator leads
Top bearing with heavy-duty removable bronze bu
Pocket for rotor leads
Laminations clamped between steel flanges and aligned by key in heavy rigid spider
Heavy short shaft with bearings ground in perfect alignment with
Form wound rotor coils assembled in open slots and braced with steel rings
Short-circuit winding of pressed cable
Extra flexible cable for leads
Regulator complete as it is lifted out of the tank

the New G-E Induction Regulator

It is offered with the assurance that it will give you satisfactory service because:

—The tank is round, built of heavy boiler plate, a design ideal to withstand high internal pressures.

—A very rigid and compact mechanical structure insures quiet operation over a long period.

—The auxiliary apparatus is very conveniently arranged and accessible.

—Voltage changes are corrected more rapidly than by any other motor-operated induction regulator.

If you have not received literature fully describing this new design, tell the nearest G-E Sales Office.

General Electric Company
Schenectady, N. Y.
Sales Offices in All Large Cities

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DUDLO

DUDLO

DUDLO

Magnet Wire & Windings

have established an enviable reputation among the electrical manufacturers for giving satisfaction wherever used in the production of electrical equipment necessitating use of material of unquestionable high quality.

We solicit the wire and coil problems of all electrical manufacturers and we guarantee them satisfaction from all angles.

DUDLO MANUFACTURING CORPORATION, FORT WAYNE, INDIANA, U.S.A.

Changing These Window Displays Paid

—*Here Are the Figures to Prove It*

Percentage increase in lamp sales due to window displays.....56 per cent		
Total increase in one week's lamp sales for five dealers		$536.25
Average increase in lamp sales for each dealer		107.25
Additional compensation for each dealer due to increased sales (at 30 per cent).....$32.17		
Direct expenses in setting up displays: Crepe paper, or cloth (cost $50, serviceable for 50 weeks) one week's use	1.00	
Labor: $30-a-week clerk working 1¼ hr. at 62½ cents an hour	.94	1.94
Average reward to dealer for changing window display		$30.23

HOW much in dollars and cents is it worth to an electrical dealer to change a window display and put in a new trim featuring some attractive line of interest to passers-by?

What increase in sales can be traced to such a new window trim, and what profit from such additional sales can be credited to the change of display itself?

An investigation to throw light on this question has been carried on with the co-operation of a group of electrical dealers, by E. F. Newkirk of the Edison Lamp Works at Harrison, N. J.

For this experiment using incandescent-lamp displays, Mr. Newkirk selected five stores. For one week, before putting in the new displays, careful records were kept

Proving again that our displays sell Edison Mazda Lamps!

THE DEALERS co-operating in this test were Edison MAZDA Lamp Agents. The service which helped them dress their windows is available to *all* Edison MAZDA Lamp Agents. The display material used is part of the wealth of material available to every qualified Edison MAZDA Lamp Agent.

And in 1925 we will have for our Agents new window and store material that will again record its sales value on the balance sheet.

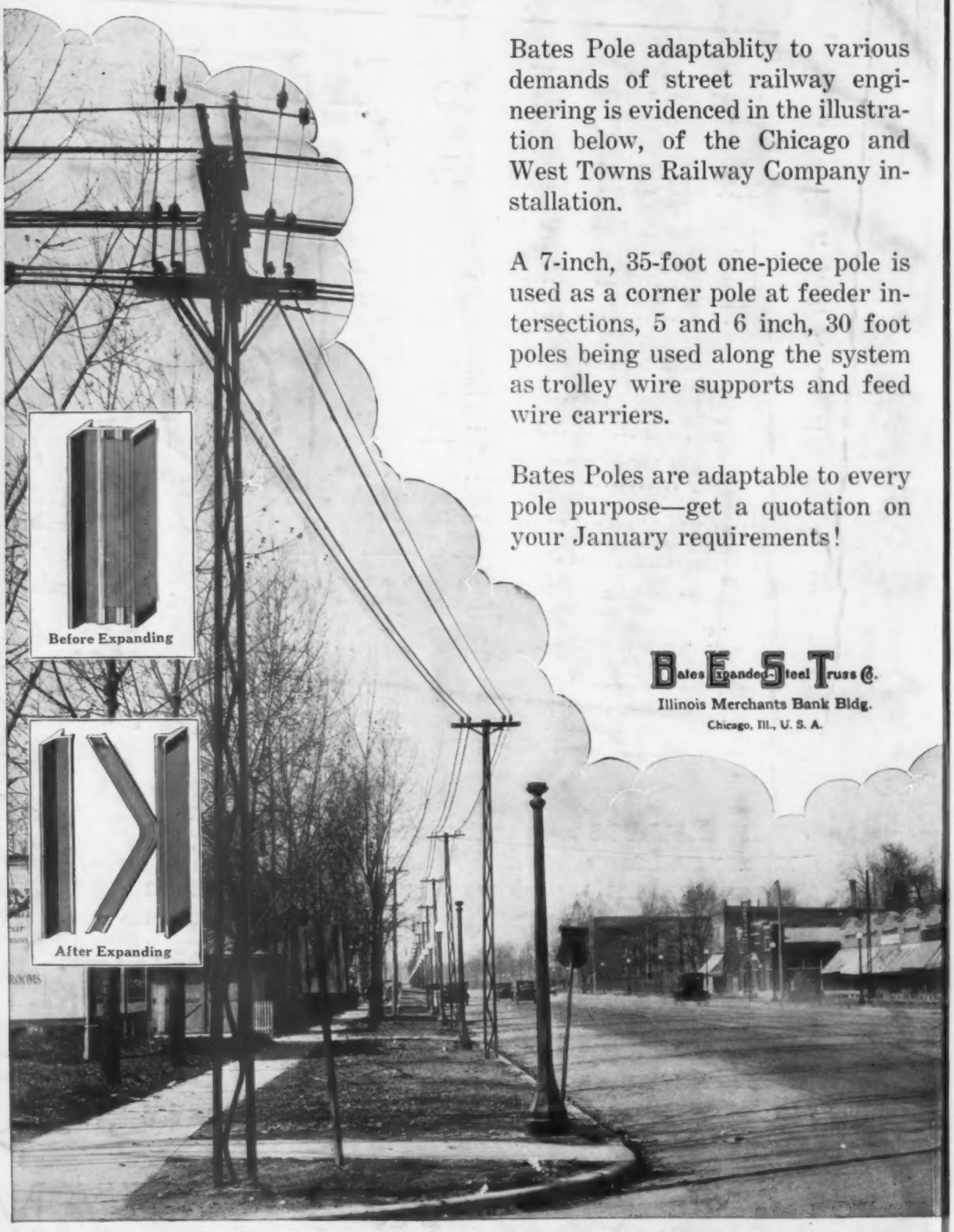
For particulars write today to our nearest district office, or to the Edison Lamp Works of General Electric Company, Harrison, N. J.

Consumers recognize this Maxfield Parrish emblem as the mark of a quality store. It is available in seven sales compelling forms.

EDISON MAZDA LAMPS

A GENERAL ELECTRIC PRODUCT

Bates Poles on the Chicago and West Towns Railway



Bates Pole adaptablity to various demands of street railway engineering is evidenced in the illustration below, of the Chicago and West Towns Railway Company installation.

A 7-inch, 35-foot one-piece pole is used as a corner pole at feeder intersections, 5 and 6 inch, 30 foot poles being used along the system as trolley wire supports and feed wire carriers.

Bates Poles are adaptable to every pole purpose—get a quotation on your January requirements!

Bates Expanded Steel Truss Co.
Illinois Merchants Bank Bldg.
Chicago, Ill., U. S. A.

BATES ONE PIECE EXPANDED STEEL POLES

LRB My'28